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Department of Conservation and Land Management, Western Australia

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Cover

Nuytsia floribunda (Labill.) R. Br. ex Fenzl (Loranthaceae) – the Western Australian Christmas Tree is one of the few arborescent mistletoes in the world. This endemic tree is a semi-parasite common in sandy soil from the Murchison River to Israelite Bay. The journal is named after the plant, which in turn commemorates Pieter Nuijts, an ambassador of the Dutch East India Company, who in 1627 accompanied the “Gulde Zeepard” on one of the first explorations along the south coast of Australia.

Cover design by Sue Marais

Photograph A.S. George

**A revision of the genus *Calectasia* (Calectasiaceae)
with eight new species described from south-west Western Australia**

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Abstract

Barrett, R.L. and Dixon, K.W. A revision of the genus *Calectasia* (Calectasiaceae) with eight new species described from south-west Western Australia. *Nuytsia* 13(3): 411–448 (2001). In this revision of the southern Australian genus *Calectasia* R. Br., eleven species are recognized. *Calectasia browneana* Keighery, K.W. Dixon & R.L. Barrett, *C. gracilis* Keighery, *C. hispida* R.L. Barrett & K.W. Dixon, *C. keigheryi* R.L. Barrett & K.W. Dixon, *C. narragara* R.L. Barrett & K.W. Dixon, *C. obtusa* R.L. Barrett & K.W. Dixon, *C. palustris* R.L. Barrett & K.W. Dixon, and *C. pignattiana* K.W. Dixon & R.L. Barrett, are described as new species from the south-west of Western Australia. A lectotype is selected for *C. grandiflora* Preiss and notes are made on the lectotype of *C. cyanea* R. Br. Keys, illustrations and distribution maps are provided for all taxa. Notes are made on the conservation status and ecology of the genus.

Introduction

Calectasia R. Br. is a genus endemic to southern Australia with eleven species recognized here. Ten are endemic to the south-west of Western Australia and *C. intermedia* is restricted to South Australia and Victoria. Three species have previously been named though Bentham (1878) and Anway (1969) recognized only *C. cyanea*. *C. grandiflora* and *C. intermedia* have since been reinstated with both George (1986) and Macfarlane (1987) suggesting that further research may result in the recognition of additional taxa. Given the paucity of specimens available to Bentham, his was a reasonable conclusion. Anway sampled widely, collecting many distinctive variants, several of which are here recognized as species. Anway took a broad view in defining only one species, with two varieties, based primarily on rhizome structure. Ironically, many species (including *C. cyanea*) are stilt-rooted (Pate *et al.* 1984, Pate & Dixon 1996), lacking a distinctly subterranean rhizome.

In recent years, an increase in the number of specimens supplemented by extensive field collections has enabled a reassessment of the reliability of identification of the rhizomatous status and other

† Two species names are authored with/by G.J. Keighery by agreement and should be cited as 'in' Barrett & Dixon not 'ex'. G.J. Keighery, Department of Conservation and Land Management, Wildlife Research Centre, PO Box 51, Wanneroo, Western Australia 6065.

characters used by earlier authors. This paper draws attention to five taxa which are recognized as priority taxa for conservation, as well as one Gazetted Rare species, and a further variety which has a limited distribution, and provides information on the ecology of the genus.

Methods

Descriptions were made primarily from fresh material, supplemented with measurements from herbarium specimens to ensure the full range of variation was recorded. Illustrations were prepared from vouchered fresh material or herbarium specimens. All taxa have been seen in the field with the exception of *C. intermedia*.

Terminology where appropriate follows McCusker (1999). Bract measurements are taken from the four innermost bracts. Leaf lamina measurements were made only from branchlet leaves as stem leaves can be considerably larger and vary with stem age.

The main characters used to separate species were: presence or absence of a distinct underground rhizome; presence of stilt roots; vigour of basal sprouting; angle of mature leaves; leaf lamina shape and indumentum; bract structure and shape; perianth texture and coloration; anther shape, size and colour; staminal filament length.

All specimens held at BM, CANB, KPBG, PERTH, and UWA at July 1999 have been examined as well as substantial collections on loan from L and MEL. All specimens collected by J.C. Anway, previously cited as being held at UWA (Anway 1969), are now at PERTH and have been examined. Further collections were made from June to December 1999. A complete list of specimens examined is held at KPBG.

Maps were created using ArcView 3.0 using a combination of locality data sourced from examined herbarium vouchers, (Western Australian Herbarium 1999, MEL database) and field collections. All specimens examined with accurate locality data have been included in the distribution maps.

Notes on the genus

Ecology

Calectasia species occupy a variety of habitats, occasionally in seasonally swampy areas, usually low heath on sand over laterite or granite or in low woodland on sand. *C. browneana*, *C. hispida* and *C. narragara* are sympatric in kwongan vegetation near Badgingarra. *C. cyanea* is restricted to near-coastal heath on sand over laterite in the Albany region. *C. gracilis* and *C. obtusa* are sympatric in low kwongan near Cape Riche with *C. gracilis* flowering later than *C. obtusa*. *C. grandiflora* (type variant) and *C. narragara* are sympatric in several locations on the Swan Coastal plain, *C. grandiflora* flowering considerably later than *C. narragara*. *C. intermedia* occurs in woodland and heath in eastern Victoria and western South Australia. *C. keigheryi* occurs in kwongan in the Fitzgerald River National Park on the south coast of Western Australia. *C. palustris* is restricted to seasonally wet areas or swamplands in the Jurien-Coorow region. *C. pignattiana* is restricted to yellow sand lenses in the central wheatbelt.

The seeds are retained within the perianth, which is distributed by wind. Large quantities of fallen flowers have been observed deposited against surrounding plants. The perianth tube has a pungent apex with stiff hairs facing upwards which allows the tube to penetrate the sand with relative ease and subsequently minimise the risk of disturbance. The perianth lobes sit at 90° to the tube, regulating the depth at which the seed is buried. This strategy is similar to *Calytrix* (Myrtaceae) where the persistent calyces similarly behave as buoyancy devices for dispersing and positioning the seed for soil burial (Craven 1987).

Calectasia species are commonly parasitised by *Cassytha* species (Lauraceae).

Pollination biology

Calectasia species are buzz-pollinated (G. Keighery pers. comm.) as in *Solanum* (Solanaceae) (Symon 1981), some species of which bear a superficial resemblance to *Calectasia*. Anway (1969) found that pollen was apparently shed prior to anthesis and records germinating pollen grains in unopened flowers, concluding that *Calectasia* is normally self-pollinated. Anway also states that style length is such as to be level with the anther pores, however most specimens examined had styles exceeding the anthers, with only a few specimens of *C. grandiflora* being at the same height as the anther pores. There is an erroneous report in Brown *et al.* (1997) based on Woldendorp (1996) that pollination by the Honey Possum (*Tarsipes rostratus*) had been observed. *Calectasia* plants are not strong enough to support the weight of a Honey Possum and have no nectar to attract such a pollinator.

Close resemblance of flowers of *C. grandiflora* to those of *Thelymitra variegata* (Lindl.) F. Muell. (Orchidaceae) which has a regular 'star-shaped' perianth with an iridescent sheen and variegated markings with a bright yellow column apex (Heberle 1999) may indicate a case of floral mimicry, which has been widely postulated for many other orchid groups in Western Australia (Jones 1988). *C. grandiflora* and *T. variegata* have a similar distribution and are often sympatric.

Cytology

Anway (1969) records $2n = 18$ for *C. gracilis*, the south coast variant of *C. grandiflora*, *C. intermedia* and *C. narragara* [all as *C. cyanea*]. Keighery (1984) records $2n = 36$ for the wheatbelt variant of *C. grandiflora* [as *C. cyanea*]. Voucher specimens are cited under individual species descriptions.

Conservation

C. pignattiana is Declared Rare Flora (Brown *et al.* (1998) as *C. arnoldii* ms.). This species is critically endangered with only one plant surviving at one site, and another population at the type locality has significantly declined in numbers from several hundred in 1995 to less than 50 plants in 1999, most likely as a result of frequent burning of the site. *C. browneana*, *C. cyanea*, *C. obtusa* and *C. palustris* are recognized as priority species for conservation as they are known from few populations, are sensitive to fire and most populations occur outside reserves. *C. grandiflora* (type variant) has a very limited distribution on the Swan Coastal Plain. *C. keigheryi* is known only from three locations in the Fitzgerald River National Park. CALM and IUCN (1994) conservation categories are listed under each taxon. The remainder of the taxa are widespread and under no immediate threat. *C. browneana*, *C. cyanea*, *C. gracilis*, *C. obtusa*, *C. palustris* and *C. pignattiana* are all obligate seeders requiring careful fire management to ensure seed is produced between fire events.

Wills (1993, pers. comm.) studied the effects of dieback (*Phytophthora cinnamomi* Rands) on Dasypogonaceae *sens. lat.* in the Stirling Ranges and found that *Calectasia* plants were restricted in their growth, but not killed, while *Dasypogon bromeliifolius* R. Br. was killed. While no voucher specimens were collected, this study probably refers to *C. grandiflora* (south coast variant), the most common taxon in the Stirling Range. Further study should be made to determine the effects of *P. cinnamomi* on stilt-rooted species.

All stilt-rooted species are thought to be killed by fire. Hundreds of seedlings have been observed of *C. gracilis* (G. Keighery pers. comm.) and *C. pignattiana* (Brown *et al.* 1998) following fire, while all adult plants had been killed. It takes (2)3–5 or more years for these species to flower and presumably a substantially longer period to attain maximum reproductive potential, therefore fire frequency must be carefully controlled to ensure survival of the species.

Habit

Calectasia species are either obligate seeders (stilt-rooted species) or resprouters (rhizomatous species). All stilt-rooted species have epicormic buds above the soil surface while rhizomatous species have epicormic buds below the soil surface. Stilt-rooted species take two forms, obligate stiling species (*C. gracilis*, *C. obtusa*, *C. palustris* and *C. pignattiana*) and facultative stiling species (*C. browneana*, and *C. cyanea*). For obligate stiling species, stilt roots may not be observable above ground in the first three years of growth; however stilt roots subsequently form with a discernible absence of a distinct subterranean rhizome. Careful observation is required when collecting specimens as several collections described as rhizomatous were found to be stilt-rooted when re-collected. For facultative stiling species, specimens can appear to have rhizomatous habit as the stilt roots may not emerge above the soil/litter surface. The term 'stilt-rooted' is retained for these species as it is entirely variable within a population and prominently stiling specimens can usually be found.

Careful superficial excavation is required to determine the true nature of the root system. Very few collections include roots (root collection is discouraged for conservation reasons) making correct identification of some material difficult. *C. grandiflora*, *C. hispida*, *C. keigheryi* and *C. narragara* are tufting clonal resprouters with a distinct subterranean rhizome, all observed to resprout following fire. *C. intermedia* is distinctive in possessing a more extensive clonal ramification and subterranean rhizome. Seed set in these clonal species is very poor with few observations or records of seedlings in nature including after fire. This is despite claims that seedlings are 'not uncommon' (Gray 1969).

Elliot & Jones (1982) have recorded adventitious roots from the upper branches for *C. cyanea sens. lat.* and probably refer to the structures akin to stilt roots (Pate *et al.* 1984). Although it is unclear which species this refers to, the current study found prominent stilt root production from the upper branches only in the rare species *C. palustris* and *C. pignattiana*. Sand-binding roots as described by Pate & Dixon (1996) are recorded for the genus *Calectasia* for the first time, occurring in all species (Figure 1).

There are some examples of both seeder and resprouter morphotypes within species of monocots in other Australian plant families (Pate & Bell 1993, Pate & Dixon 1996, Pate *et al.* 1999), however the differences in growth form for *Calectasia* (with no intergrading specimens) are considered sufficient to use this character to distinguish between species in this genus.

The stilt habit is unique in the Dasypogonaceae *sens. Clifford et al.* (1998) with more prominent and larger stilt roots than most other stilt-rooted plants (e.g. Anthericaceae, Droseraceae, Stylidiaceae

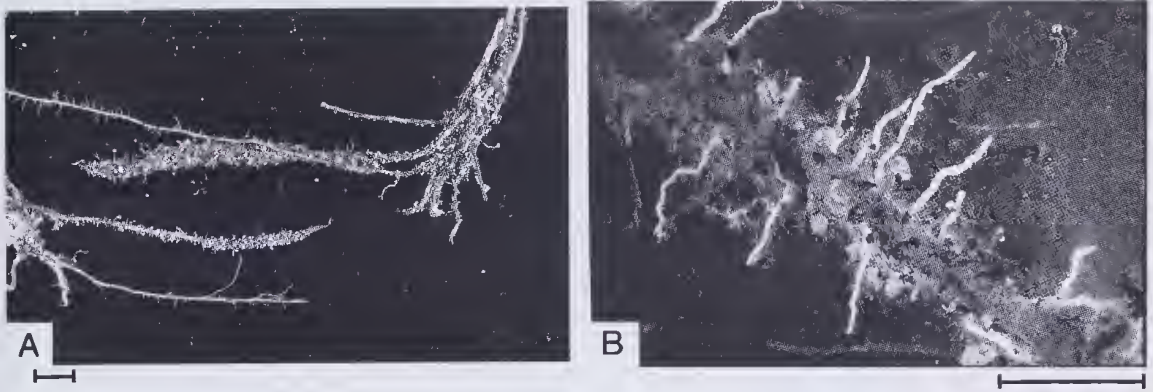


Figure 1. Sand-binding roots of *Calectasia narragara* (R.L. Barrett & K.W. Dixon 1306) A – sand bound to root; B – microphotograph of root hairs. Scale bars: A = 1 cm, B = 1 mm.

and western species of Laxmanniaceae). The stilt roots of *Calectasia* species are similar in size to *Romnaldia grallata* Henderson (Henderson 1981) [Laxmanniaceae *sens.* Angiosperm Phylogeny Group (1998)] and *Borya* species (Boryaceae), particularly the tropical species *B. subulata* C.A. Gardner.

Vegetative characters

Branched trichomes have been recorded for *Calectasia* by Fahn (1954), occurring on the margins of the leaf sheaths of all species. *C. palustris* has been observed with a profusion of marginal trichomes giving the sheath apex a woolly appearance. One specimen of *C. narragara* (C.L. Wilson 770) has leaf laminae with pilose marginal hairs, but was otherwise glabrous. Most specimens have scabrid hairs on the margin of the leaf lamina, absent in only *C. browneana*, *C. obtusa* and *C. pignattiana*. Dense pilose indumentum on the surfaces of the leaf lamina is found only in *C. browneana* and a dense hispid indumentum only in *C. hispida*. Scattered branched trichomes are found on the leaf lamina of *C. palustris* and occasionally on *C. grandiflora*. All other species have more or less glabrous leaf lamina surfaces.

C. pignattiana has a large internode length and reflexed leaf laminae. New season's growth (of all species) can have greater internode length and larger diameter stems than older plants, with new shoots of *C. cyanea* appearing like a robust variant of *C. pignattiana*.

Leaf, stem and root anatomy of *Calectasia* were first studied in detail by Fahn (1954) in a review of the anatomy of the family Xanthorrhoeaceae (*sens. lat.*) with further studies by Rudall & Chase (1996). Fahn studied two species of *Calectasia*, *C. grandiflora* [as *C. sp. nov.*] and *C. narragara* [as *C. cyanea*]. Rudall & Chase studied only *C. narragara* [as *C. cyanea*].

Floral characters

Perianth structure is recorded as either chartaceous (fading white) or thinly coriaceous (usually fading brown or red). Perianth fading is due to a combination of bleaching due to light and/or contact with water.

Anther pores are either terminal or just below the apex (facing inward). This character can be represented in either state for some species, however intermediate forms (gradation between terminal and sub-terminal) are not found. For most taxa anther pore position is fixed.

Relationships

Relationships within the genus require further research and no attempt is made to present a formal infrageneric classification. The following groupings have been derived using the number of characters shared between each species. The first group consists of *C. browneana*, *C. hispida* and *C. narragara* which all lack vestigial leaf laminae on their floral bracts. Group two comprises *C. cyanea*, *C. gracilis* and *C. pignattiana*, which are all stilt-rooting species with perianth lobes fading white. Group three comprises *C. grandiflora*, *C. palustris* and probably *C. obtusa*, which are large-flowered species with perianth lobes fading to red/brown. Group four includes *C. intermedia* and *C. keigheryi* which both have golden pilose hairs on the perianth tube; narrow perianth lobes not fading red/brown and relatively short staminal filaments. Group two is thought to be closest to group three, these groups to group four and group one most distant.

Taxonomy

Calectasiaceae Endl. in Fenzl & Endl., Gen. Pl. i: 132 (1836) [as *Calectasieae*].

Type: *Calectasia* R. Br.

Juncaceae subfam. *Calectasioideae* Meisn., Pl. Vasc. Gen.: Tab. Diagn. 406 (1842) [as *Calectasieae*].
– *Juncaceae* tribe *Calectasieae* Benth., Fl. Austral. 7: 93, 119 (1878).

A monogeneric family, comprising only *Calectasia*, closely allied to *Dasypogonaceae sens. Brummitt* (1992). The original publication of the family name has often been cited as 'Endl., Gen. Pl. viii: (1838)', however the name was first published in Endlicher (1836).

The family *Calectasiaceae* is recognized as distinct from *Dasypogonaceae* based on recent DNA evidence (Barthlott *et al.* in prep.). The Angiosperm Phylogeny Group (1998) included *Calectasiaceae* within *Dasypogonaceae*, placing the family in an unresolved position within the Commelinoid clade. Studies by Barthlott *et al.* (in prep.) resolve *Calectasiaceae* and *Dasypogonaceae* as sister families within the Arecales. The position of *Calectasia* has varied greatly in the past. Originally placed in *Juncaceae* (Brown 1810, Meisner 1842, Bentham 1878), then placed in its own family (Endlicher 1836), it has also been included in *Liliaceae* (Jessop & Toelken 1986), *Xanthorrhoeaceae* (Anway 1969, George 1986, Conn 1994, Mabberley 1997), *Dasypogonaceae* (Rudall & Chase 1996, Angiosperm Phylogeny Group 1998, Clifford *et al.* 1998), or accepted as *Calectasiaceae* (Dahlgren *et al.* 1985, Brummitt 1992, Takhtajan 1997, Watson & Dallwitz 1999, Barthlott *et al.* in prep.). In addition, *Calectasiaceae* is recognized in the National register of plant nomenclature for Australia (Chapman 1999).

Calectasia is unique in the *Dasypogonaceae sens. Clifford et al.* (1998) in many aspects, the most obvious features being solitary flowers with a chartaceous and persistent perianth. The persistence of the perianth and its apparent use for dispersal of the seeds is unknown in the remainder of this group and is an uncommon feature in the petaloid eumonocots. Stilt roots are not found in any other genera of the *Dasypogonaceae sens. Clifford et al.* (1998).

Calectasia R. Br., Prodr. 264 (1810).

Type: Calectasia cyanea R. Br.

Stilt-rooted or rhizomatous undershrubs with sand-binding roots. *Leaves* sessile; sheath closely appressed to stem, persistent. *Flowers* actinomorphic, bisexual, sessile, terminal, solitary. *Sepals and petals* undifferentiated, united in a tube in lower half, chartaceous or thinly coriaceous, blue or purple, fading white, or brown with red or russet markings. *Stamens* inserted at base of perianth lobes; anthers attached at base, linear, prominently exerted, yellow, usually turning red or brown with age, anther filaments sigmoidal to straight. *Ovary* 1-locular, superior; ovules 3. *Style* slender, exerted, exceeding stamens; stigma simple. *Fruit* indehiscent (anthocarpous), 1-seeded, falling with perianth. *Seed* oblong, with a membranous testa.

Distribution. Widespread in the south-west of Western Australia, from Kalbarri to Esperance with a disjunction to the eastern border of South Australia and western Victoria (Figure 2). The distributions of individual species are shown in Figure 3.

Etymology. From Greek – *calos* meaning beautiful and – *ectasia* meaning stretching out, in reference to the star-shaped perianth lobes (Sharr 1996).

Notes. This is a taxonomically isolated genus thought to be most closely related to *Dasypogon* (Dasypogonaceae). Often confused with *Calytrix* (Myrtaceae) due to the similar appearance of several species.



Figure 2. Distribution of the genus *Calectasia*.

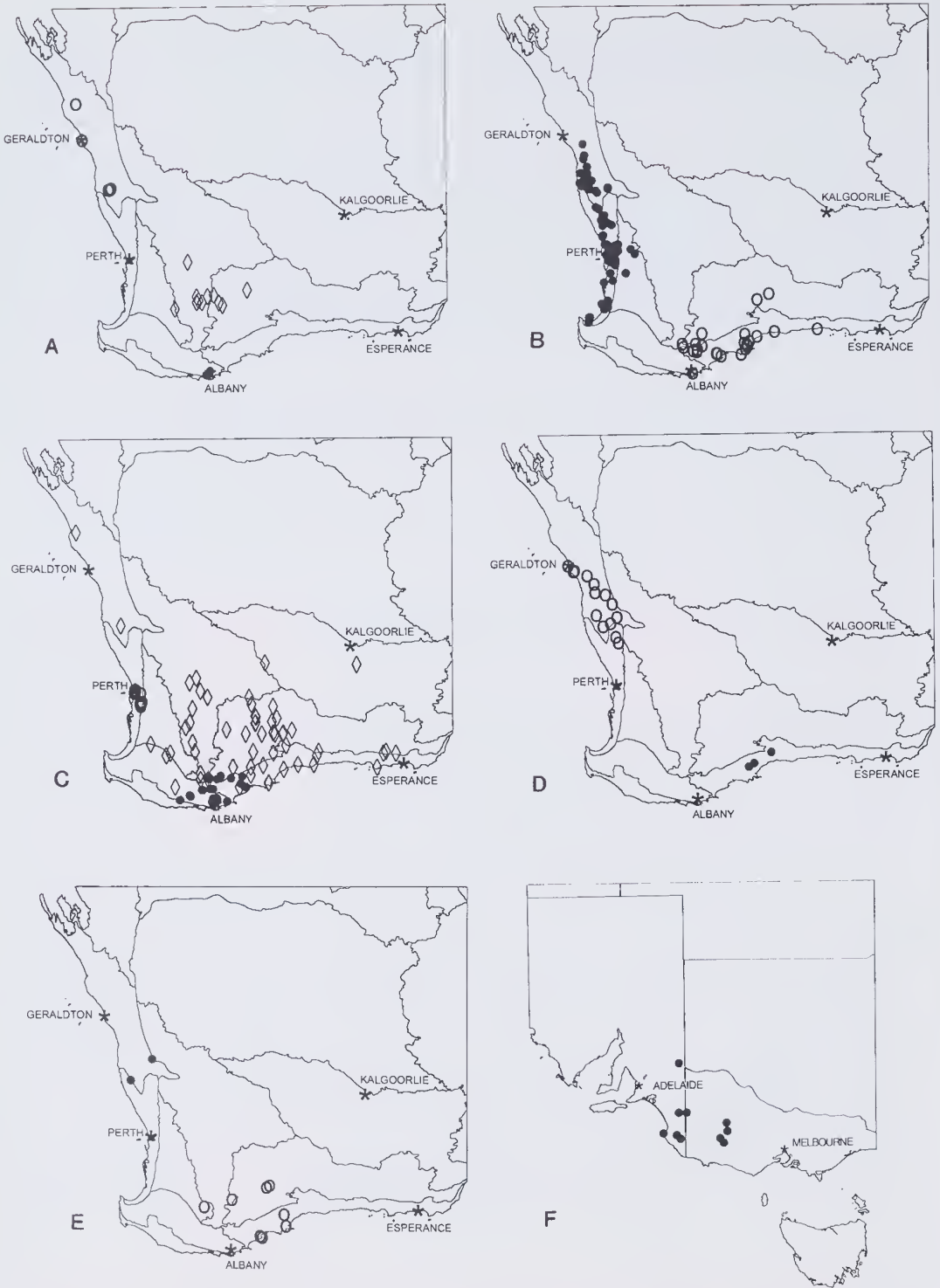


Figure 3. Species distribution A – *Calectasia browneana* o, *C. cyanea* ●, *C. pignattiana* ◊; B – *C. gracilis* o, *C. narragara* ●; C – *C. grandiflora* (type variant) o, (wheatbelt variant) ◊, (south coast variant) ●; D – *C. hispida* o, *C. keigheryi* ●; E – *C. palustris* ●, *C. obtusa* o; F – *C. intermedia* ●. Western Australian maps show the phytogeographic regions of Beard (1980).

Key to *Calectasia* species

- 1: Plant not rhizomatous, usually with stilt roots 2
- 1 Plant rhizomatous, never with stilt roots 7
- 2: Leaf laminae reflexed (90°–140°), not overlapping (Quairading to Lake Grace) ***C. pignattiana***
- 2 Leaf laminae not reflexed (on mature branchlets) (0°–45°) 3
- 3: Leaf lamina densely pilose; (Kalbarri to Eneabba) ***C. browneana***
- 3 Leaf lamina glabrous (margins often scabrous) 4
- 4: Leaf lamina without mucro, apex obtuse to bluntly apiculate (Kojonup to Hopetoun) ***C. obtusa***
- 4 Leaf lamina with a pungent mucro over 0.2 mm long 5
- 5: Leaf lamina 1.0–1.3 mm wide; staminal filaments 2.6–3.0 mm long; facultative stiling species (Albany region) ***C. cyanea***
- 5 Leaf lamina 0.4–0.7 mm wide; staminal filaments 1.0–2.2 mm long; obligate stiling species 6
- 6: Slender; perianth tube 5.7–6.9 mm long, lobes 8.1–9.5 mm long; young leaves appressed (Stirling Range to Albany to Frank Hann National Park) ***C. gracilis***
- 6 Robust; perianth tube 9.9–10.1 mm long, lobes 10.2–12.2 mm long; young leaves rarely appressed (Cervantes to Coorow) ***C. paustris***
- 7: Leaf lamina hispid above (Kalbarri to Gillingarra) ***C. hispida***
- 7 Leaf lamina glabrous above (margin often scabrous) 8
- 8: Rhizome long, decumbent (South Australia and Victoria) ***C. intermedia***
- 8 Rhizome short, compact (Western Australia) 9
- 9: Anther apex caudate, base constricted with a short skirt (not turning red with age; perianth lobes 8.1–12.5 x 1.3–2.1 mm, thinly coriaceous) (Fitzgerald River National Park) ***C. keigheryi***
- 9 Anther apex obtuse to emarginate, base cordate 10
- 10: Bracts brown-purple, often with vestigial leaf lamina; perianth lobes 11.9–21.5 x 2.0–4.7 mm, thinly coriaceous, aging pale brown and dark red; anthers not turning red with age (widespread, Kalbarri to Esperance) ***C. grandiflora***
- 10 Bracts white, papery, lacking vestigial leaf lamina; perianth lobes 8.7–12.6 x 2.0–3.0 mm, chartaceous, aging white; anthers turning red with age (Geraldton to Busselton) ***C. narragara***

Calectasia browneana Keighery, K.W. Dixon & R.L. Barrett, *sp. nov.*

Calectasiae hispidae affinis sed foliis densi pilosis, rhizomate nullo differt.

Typus: 2.5 km east of Brand Highway on Coorow–Greenhead road, 30°03'06"S, 115°21'58"E, Western Australia, 3 July 1999, R.L. Barrett 1299 (*holo*: PERTH05542464; *iso*: AD, ALB, BM, CANB, K, KPBG, L, MEL, UWA).

Undershrub, stilt-rooted; rhizome absent. *Stems* to 60 cm, with many very short lateral branches. *Leaf lamina* 8.3–15.2 x 0.2–0.4 mm, with weakly barbed pilose hairs; apex cuspidate with a pungent mucro c. 0.25 mm long; sheath with weakly barbed pilose hairs. *Bracts* 11.1–11.4 x 2.0–3.1 mm, white, thin, apex acuminate, margins pilose. *Perianth*: tube 7.2–8.0 mm long, pilose in lower half; throat glabrous; lobes chartaceous, 8.8–10.5 x 2.6–3.0 mm, apex acuminate, pale blue-pink, fading, pilose on abaxial surface. *Staminal filaments* 2.1–2.9 mm long. *Anthers* 3.5–4.3 x 1.0–1.2 mm, apex incurved, yellow, turning orange-red with age, pores terminal or below apex. *Style* 9.3–10.1 mm long, exceeding anthers. *Seeds* not seen. (Figure 4)

Other specimens examined. WESTERN AUSTRALIA: 1.2 km S of intersection of Coorow–Greenhead road on Brand Highway, 50 m NW of rest area, 30°04'11"S, 115°19'52"E, 3 July 1999, *R.L. Barrett* 1300 (KPBG, PERTH); 3.3 km W of Brand Highway, on S side of Greenhead–Coorow road near fence, 30°04'08"S, 115°17'53"E, 1995, *K.W. Dixon s.n.* (KPBG, NSW, PERTH); E of Burry Rd, 6 Aug. 1986, *A.S. George* 16791 (PERTH); Champion Bay, [28°46'S, 114°38'E], 1873, *C. Gray s.n.* (MEL); 3 km W of Brand Highway, off Greenhead–Coorow road, 30 July 1995, *M. Hislop s.n.* (PERTH); 1.5 km S of Greenhead–Coorow road, on Brand Highway, on private property on W side of Highway, 30°04'40"S, 115°19'30"E, 29 June 1997, *M. Hislop* 786 (PERTH); Kalbarri National Park, 0.35 km N of Kalbarri–Ajana road on turnoff to Hawkes Head, 27°49'10"S, 114°27'46"E, 5 Aug. 1996, *G.J. Keighery & N. Gibson* 1922 (PERTH).

Distribution. South West Botanical Province. An uncommon species recorded mainly in the Coorow–Eneabba region, with a disjunct population near Kalbarri. (Figure 3A)

Habitat. White-grey sand over laterite in kwongan with emergent *Banksia attenuata* R. Br., *Eucalyptus tottiana* F. Muell. over *Adenanthos cygnorum* Diels, *Banksia candolleana* Meisn., *Calothamnus quadrifidus* R. Br., *Eremaea beaufortoides* Benth., *Grevillea shuttleworthiana* subsp. *canarina* Olde & Marriott, *Hypocalymma angustifolium* (Endl.) Schauer, *Scholtzia laxiflora* Benth. and *Stirlingia latifolia* (R. Br.) Steud., occasionally with *Kingia australis* R. Br.

Flowering period. June to August.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Two. IUCN: VUD1. This species occurs in one large national park and in four roadside populations, two of which extend to private land. Further studies are urgently required to determine the fire response of this species.

Etymology. The specific epithet honours John and Judy Browne, owners of 'Breakaway', on whose property this species occurs and who have endeavoured to conserve high conservation value kwongan vegetation on their land.

Affinities. Closest to *C. hispida* and *C. narragara*, differing principally in the pilose leaf lamina and facultative stiling habit.

Notes. The common name of Browne's Tinsel Lily is suggested for this species. This is a facultative stiling species which may appear rhizomatous as soil often aggregates at the plant base forming a raised mound around the roots. It does not form a distinct subterranean rhizome and all shoots arise from above the soil surface. There is very minor storage of starch in the stem and in central pith of stilt roots suggesting that this species would not have sufficient reserves to resprout following fire. While its fire response has not been observed, this species is almost certainly killed by fire. The dense pilose indumentum on the leaf laminae is unique in the genus.



Figure 4. *Calectasia browneana* A – habit; B – leaf; C – leaf apex; D – anther (adaxial side L, abaxial side R). Scale bars: A = 1 cm, B–D = 1 mm. Drawn from R.L. Barrett 1299.

Calectasia cyanea R. Br., Prodr. 264 (1810). *Type*: Princess Royal Harbour, King George Sound, Western Australia, December 1801, *R. Brown s.n.* [No. 5778 added later] (*lecto*: BM 00593503 *fide* Anway (1969); *isolecto*: BM 000593504, MEL 247846).

Undershrub, usually with stilt roots; rhizome absent. *Stems* to 40 cm, with few short lateral branches, crowded at the apex. *Leaves*: lamina 6.5–13.2 x 1.0–1.3 mm, glabrous, margins scabrous, apex acute with a pungent mucro 0.5–0.7 mm long; sheath with sparse branched trichomes with branched trichomes on margin. *Bracts* 6.8–7.5 x 1.6–2.3 mm, light green to pale brown, lamina apex and margins with branched trichomes, apex with vestigial leaf lamina 2.5–3.1 x 0.5 mm. *Perianth*: tube 6.5–8.0 mm long, pilose in lower half–two thirds; throat with tangle of short hairs; lobes chartaceous, 8.3–11.2 x 2.1–3.3 mm, apex acute, dark blue, fading to white, pilose on abaxial side. *Staminal filaments* 2.6–3.0 mm long. *Anthers* 4.9–5.2 x 0.9–1.2 mm, yellow, turning orange-red with age, pores terminal. *Style* 9.5–(12) mm long, exceeding anthers. *Seeds* not seen. (Figure 5)

Other specimens examined. WESTERN AUSTRALIA [precise localities withheld]: Torndirrup National Park, 25 Nov. 1999, *R.L. Barrett, N. Bluethgen & K. Reifenrath* 1376 (ALB, BM, CANB, K, KPBG, MEL, PERTH, UWA); Torndirrup National Park, 26 July 1991, *C.A. Hortin* 2/6 (PERTH); Torndirrup National Park, 1 Oct. 1986, *G.J. Keighery* 11733 (PERTH); King George Sound, 1836, *A. Macleays s.n.* (PERTH); Torndirrup National Park, 7 Aug. 1988, *P. Morris* Sp10TN1 (PERTH); Cape ... [?West Cape Howe], mid 1800's, *A.F. Oldfield s.n.* (MEL); south-west Australia, *Anon. s.n.* (MEL); King George Sound, 1 Aug. 1884, *Anon.* 47 (MEL); [?King George Sound], *Anon.* 1016 (ex Herb. Paris) (BM); King George Sound, 1880, *W. Webb s.n.* (MEL); King George Sound, 1888, *W. Webb s.n.* (MEL); King George Sound, 1891–2, *W. Webb s.n.* (MEL).

Distribution. Restricted to Torndirrup National Park and Albany region of the South West Botanical Province. (Figure 3A)

Habitat. Yellow sand over laterite in low heath with *Adenanthos cuneatus* Labill., *Allocasuarina humilis* (Otto & Dietr.) L.A.S. Johnson, *Banksia grandis* Willd. (dwarf variant), *Hakeaprostrata* R. Br., *Jacksonia horrida* DC., *Lysinema ciliatum* R. Br., *Melaleuca* sp., *Petrophile squamata* R. Br. and Poaceae sp.

Flowering period. (July) August to December.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Two. IUCN: VUD1. This species is only known from a small area from King George Sound and Torndirrup National Park. The only mature population seen (in Torndirrup National Park) consisted of only five tussocks totalling c. 30 ramets (where new shoots are produced from the base of the stem which may detach from the parent plant with time, the new shoot first producing its own stilt roots). Approximately 50 seedlings were found in an adjacent area burnt four years previously where all adult plants had been killed. These seedlings were c. 3 years old though only 3–6 cm tall. They require monitoring to determine percentage surviving to maturity and age of reproductive maturity. Many old collections give only King George Sound as the collection location. Much of this area has now been developed as the site of the City of Albany and for agriculture. Further surveys are urgently required to determine the current extent of this species.

Etymology. The specific epithet is from the Latin – *cyaneus*, meaning dark blue, in reference to the flower colour.

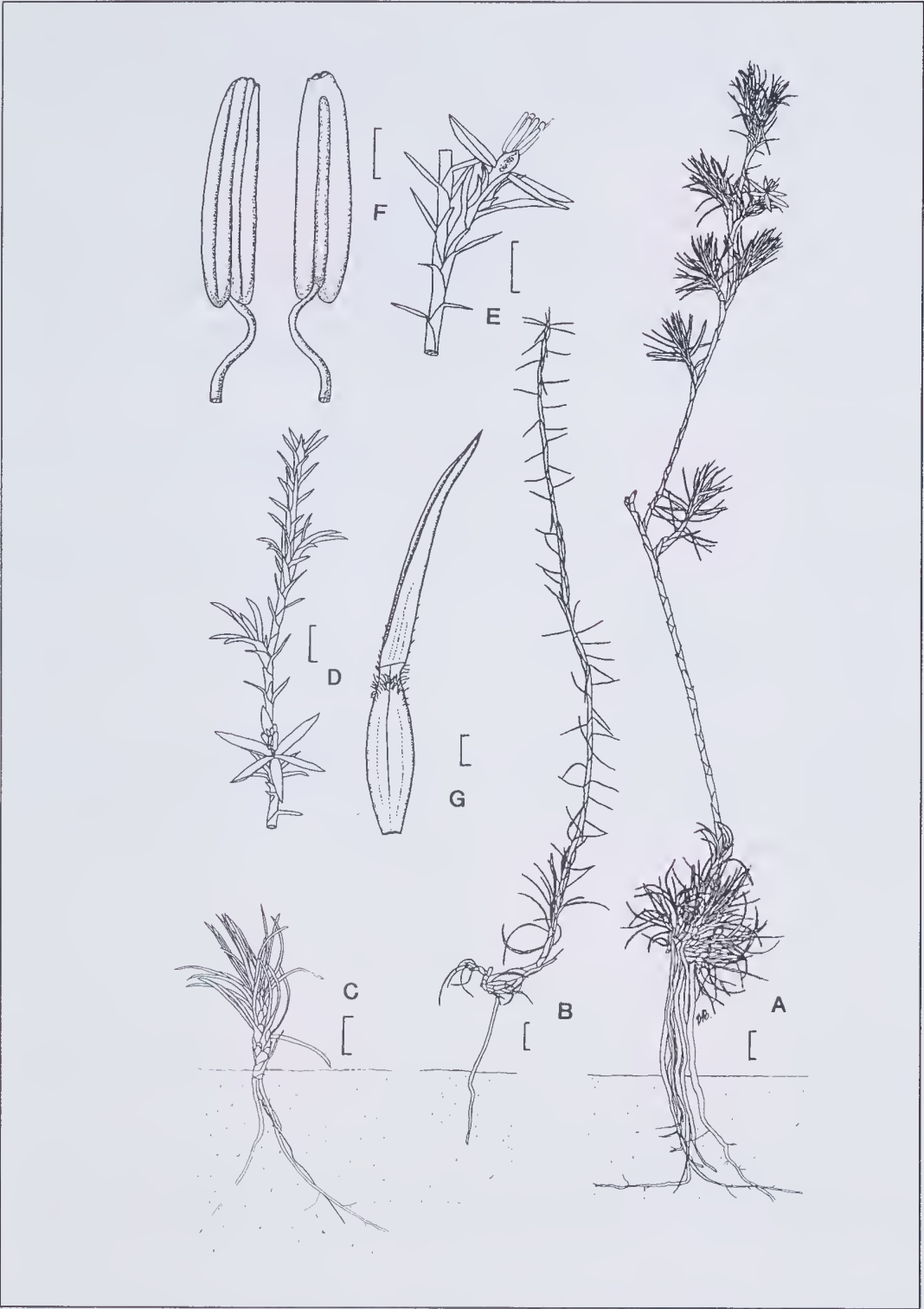


Figure 5. *Calectasia cyanea* A,B – habit; C – seedling (3 yrs); D – young branchlet; E – flower; F – anther (adaxial side L, abaxial side R); G – leaf. Scale bars: A–E = 1 cm, F, G = 1 mm. Drawn from R.L. Barrett *et al.* 1376.

Typification. Two type sheets at BM contain 12 specimens, representing two taxa collected by several botanists. Anway (1969) selected Robert Brown's collection 'Bennett's No. 5778' as the lectotype (BM 00593503). This sheet includes eight specimens, which appear to show two different variants. Examination of specimens in the field at Torndirrup National Park found this variation to be an artefact of the age of the branches. All eight pieces on this sheet are accepted as forming the lectotype as designated by Anway.

The second sheet contains four specimens representing four separate collections and two taxa. The central specimen (BM 000593504) is the only element that can be considered part of the original type set and is here regarded as an islectotype. A second specimen of *C. cyanea* (BM 000593507) is not regarded as an islectotype as it appears to have not been collected by Brown. The remaining two specimens on the same sheet (BM 000593505 and BM 000593506) belong to *C. gracilis*. Specimens on the sheet MEL 247846 match the type sheet well and there is no indication that this is part of a separate collection so it should be regarded an islectotype.

Affinities. Closest to *C. gracilis* and *C. pignattiana*, differing in its clumping habit (due to vigorous basal sprouting). It also differs from *C. pignattiana* in its non-reflexed mature leaves.

Notes. This species has previously been considered to be widespread in the south-west of Western Australia. Many publications include illustrations labelled *C. cyanea*, most of which are now regarded as *C. narragara*.

C. cyanea has the latest flowering period in the genus, predominantly from late spring to early summer.

The following specimen is of uncertain placement: gravel reserve corner Rockwell Rd and Albany Highway, 45 km N of Mount Barker, 34°16'57"S, 117°49'28"E, 7 Sep. 1986, *E.J. Croxford* 4592 (ALB *n.v.*, PERTH). This location has been searched twice without finding any plants. Only branches were collected and the rooting habit was not recorded. This specimen is similar in appearance to *C. cyanea* however it is well outside the known range of this species in very different habitat. Further specimens including rooting habit are required to determine the status of this taxon.

Calectasia gracilis* Keighery, *sp. nov.

Calectasiae pignattianae affinis sed habito parviore, foliis junioribus adpressis differt.

Typus: c. 7 km N of Cape Riche on Sandalwood Road, 34°34'52"S, 118°43'08"E, Western Australia, 4 Oct. 1999, *R.L. Barrett, K.W. Dixon & M.D. Barrett* 1344 (*holo:* PERTH 05542448; *iso:* AD, ALB, BM, CANB, K, KPB, L, MEL, NSW, PERTH 05542456, UWA).

Undershrub with stilt roots; rhizome absent. *Stems* to 30(45) cm, with many short lateral branches. *Leaves:* lamina 5.4–7.2 x 0.5–0.6 mm, glabrous, margins finely scabrous; apex acute-obtuse usually with a pungent mucro 0.2–0.5 mm long; sheath with branched trichomes on margin. *Bracts* 6.2–7.5 x 1.8–1.9 mm, white, thin, margins glabrous, apex with vestigial leaf lamina 1.6–1.8 x 0.5 mm. *Perianth:* tube 5.7–6.9 mm long, pilose in lower half; throat with tangle of short hairs, lobes thinly coriaceous, 8.1–9.5 x 2.0–2.8 mm, apex acuminate, blue, fading to pale blue, pilose on abaxial side. *Staminal filaments* 1.9–2.2 mm long. *Anthers* 5.0–5.4 x 1.2–1.4 mm, yellow, turning orange-red with age, pores below apex. *Style* 6.2–7.2 mm long, exceeding anthers. *Seeds* not seen. $2n = 18$ (Anway 257) *fide* Anway (1969). (Figure 6)

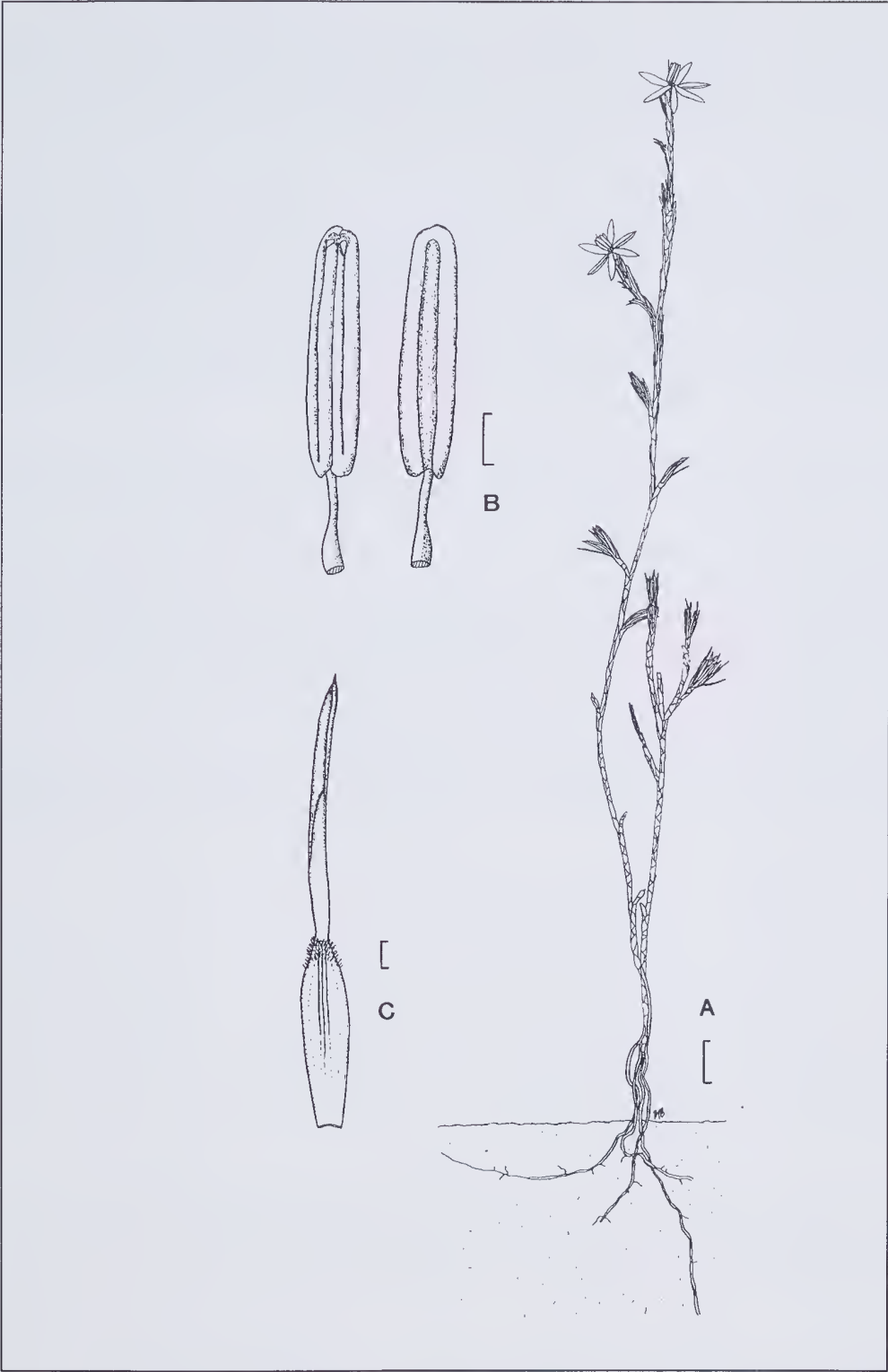


Figure 6. *Calectasia gracilis* A – habit; B – anther (adaxial side L, abaxial side R); C – leaf. Scale bars: A = 1 cm, B, C = 1 mm. Drawn from R.L. Barrett et al. 1343.

Selected specimens examined (12 of 36). WESTERN AUSTRALIA: 37 mile peg [c. 59.5 km] from Albany on Chester Pass Rd, 23 Aug. 1965, *J.C. Anway* 257 (PERTH); between road and Wellstead Roadhouse, 34°29'37"S, 118°36'18"E, 4 Oct. 1999, *R.L. Barrett, K.W. Dixon & M.D. Barrett* 1343 (KPBG); King George Sound, ?*R. Brown* s.n. (ex [herb] Bauer) (BM); 4 km N of Hopetoun, 33°54'54"S, 120°08'25"E, 8 May 1996, *R. Davis* RD 687 (PERTH); 37 mile peg [59.5 km N], Albany-Borden road, 12 Aug. 1964, *A.S. George* 6397 (PERTH); Quaalup, Gairdner River, 28 Oct. 1965, *A.S. George* 6951 (PERTH); 6.5 km S of Salt River Rd on Red Gum Pass Rd, 24 Oct. 1993, *A.S. George* 17153 (PERTH); near Mount Bland, south Coast, 3 Oct. 1970, *B.R. Maslin* 1035 (PERTH); Blackwood River, 1883, *M. McHard*, s.n. (MEL); base of the Stirling Ranges, Oct. 1867, *F. Mueller* s.n. (MEL); 15.5 miles [25 km] W of Ongerup, 22 Aug. 1962, *K. Newbey* 355 (PERTH); 1.7 km S of Mt Gibbs, c. 34 km ENE of Lake King, 10 Aug. 1979, *K. Newbey* 5482 (PERTH); Bremer Bay, 1900, *J. Wellstead* s.n. (PERTH).

Distribution. From Albany and Stirling Range National Park east to Hopetoun with an early record apparently from the Blackwood River, South West Botanical Province. (Figure 3B)

Habitat. Quartzite sands, in mallee woodland or heath, often over laterite or granite. Recorded in association with *Banksia* sp., *Darwinia vestita* (Endl.) Benth. and *Eucalyptus redunca* Schauer.

Flowering period. May to October.

Conservation status. Scattered in the Stirling Range National Park, Fitzgerald River National Park, Cape Riche, and extending east to Frank Hann National Park. Uncommon, but widespread and not under immediate threat.

Etymology. The specific epithet – *gracilis* (Latin) means slender.

Affinities. Closest to *C. pignattiana* differing principally in having appressed rather than reflexed leaves and a smaller stature.

Notes. The common name of Graceful Tinsel Lily is suggested for this species.

There are two collections which appear to fit *C. gracilis*, however their locations are well outside the known range of any modern collections (Murchison's River, c. 1853, *J. Drummond* 446 (BM 000593505 (labelled only 'W. Australia'), MEL 2064143) & Greenough Flats, [1874], *C. Gray* s.n. (MEL 2064153)). It is uncertain whether these collections have been incorrectly labelled or whether *C. gracilis* may have once had a wider distribution including the northern kwongan.

This species is killed by fire (G. Keighery pers. comm.).

Calectasia grandiflora Preiss in J.G.C. Lehmann, Pl. Preiss. 2(1): 53 (1846). *Type:* Darling Range, near Perth, Western Australia, 1839, *L. Preiss* 1975 (*lecto:* MEL 247847, here designated; *isolecto:* L 0109478, MEL 247848, ?MEL 2064111 *p.p.* (see below)).

Undershrub without stilt roots, rhizome short, clonal. *Stems* to 65 cm, with many lateral branches. *Leaf* lamina 5.2–16.5 x 0.4–1.2 mm, glabrous or with branched trichomes on abaxial side, becoming glabrous, margins finely scabrous; apex acute with a pungent mucro 0.3–0.6 mm long; sheath with branched trichomes on margin, otherwise glabrous. *Bracts* papery-thickened with a pale brown apex, outer bracts brown to reddish brown, 9.6–11.2 x 1.3–2.4 mm, apex sometimes with vestigial leaf lamina

1.5–2.5 x 0.4–0.5 mm, margins pilose or with branched trichomes. *Perianth* tube 9.4–12.3 mm long, pilose in lower fifth to third; throat with tangle of short barbed hairs, lobes thinly coriaceous, 11.9–21.5 x 2.6–4.7 mm, apex acute to acuminate, blue, becoming red, pilose on abaxial side. *Staminal filaments* 2.7–4.2 mm long. *Anthers* 3.5–6.7 x 0.7–1.5 mm, yellow, not turning orange-red with age, pores terminal. *Style* 11.2–14.2 mm long, exceeding anthers. *Seeds* not seen. (Figures 7,8)

Specimens examined (type variant). WESTERN AUSTRALIA: Wilson Street in old dump area, Armadale, 32°09'29"S, 116°00'48"E, 14 Aug. 1965, *J.C. Anway* 224 (PERTH); Mundijong Rd, 1 km E of intersection with Kargotich Rd, 16 Dec. 1999, *R.L. Barrett & K.W. Dixon* 1379 (KPBG); Mundijong Rd, 200 m E of intersection with Kargotich Rd, 32°17'46"S, 115°57'21"E, 6 Nov. 1997, *R. Davis* 4461 (PERTH); 1 km N of Serpentine, 32°21'27"S, 115°58'23"E, 18 Sep. 1982, *G.J. Keighery* 5242 (PERTH); Brixton Rd [Street], Beckenham, 32°01'18"S, 115°58'00"E, 23 Sep. 1983, *G.J. Keighery* 6282 (CANB, K, PERTH); Swan River, 1850's, *W. Mylne s.n.* [7832] (MEL, PERTH); Around Perth, 1839, *J.A.L. Preiss* 1974B (MEL).

Selected specimens examined (south coast variant) (10 of 55). WESTERN AUSTRALIA: junction of Rocky Crossing Rd and Willying Rd, N of Albany, 35°03'S, 117°54'E, 30 Nov. 1965, *J.C. Anway* 253 (PERTH); slope of hill (N facing) on W side of Bremer Bay, 34°23'S, 119°23'E, 25 Aug. 1965, *J.C. Anway* 280 (PERTH); SW of Wellstead, 1.1 km W on Mettler Rd from Sandlewood Rd, 34°32'28"S, 118°38'12"E, 4 Oct. 1999, *R.L. Barrett, K.W. Dixon & M.D. Barrett* 1348 (AD, BM, CANB, KPBG, L, MEL, PERTH, UWA); 0.8 km into Stirling Range National Park on Chester Pass Road, 34°28'06"S, 118°03'48"E, 4 Oct. 1999, *R.L. Barrett, K.W. Dixon & M.D. Barrett* 1351 (ALB, K, KPBG, NSW, PERTH); Red Gum Pass, Stirling Range National Park, 34°22'S, 117°48'E, 15 Sep. 1965, *A.C. Beaglehole* ACB 12945 (CANB, PERTH); Hunton Rd, off Nanarup Rd, E of Albany, 34°56'S, 118°00'E, 1 Sep. 1984, *E.J. Croxford* 3593 (ALB n.v., PERTH); Mt Josephine, Stirling Ranges, 34°20'S, 117°43'E, 9 Oct. 1962, *A.R. Fairall* 485 (KPBG, PERTH); Surrey Downs Rd, Porongurup, 1 km S of rubbish dump, 1 Oct. 1999, *J. Hartley s.n.* (KPBG, PERTH); Mount Barker Hill, 34°39'S, 117°38'E, 1 Nov. 1995, *T.R. Lally* 850 (PERTH); Tick Flat, Two Peoples Bay Nature Reserve, 35°00'S, 118°11'E, 5 Oct. 1972, *G.T. Smith & L.A. Moore s.n.* (PERTH).

Selected specimens examined (wheatbelt variant) (8 of 76). WESTERN AUSTRALIA: sources of the Blackwood River, 1889, [*M.*] *Cronin, s.n.* (MEL); 2 km S of Mogumber, 31°10'S, 116°04'E, 26 Aug. 1979, *M. Fagg* 1039 (CANB); Rabbit-proof fence towards Starvation Boat Harbour, 33°54'S, 120°34'E, 15 Aug. 1965, *C.A. Gardner* 16152 (PERTH); 9 km E of Lake King along Rd to Kumarl, 34°04'14"S, 119°46'23"E, 13 Oct. 1991, *W. Greuter* 22786 (PERTH); 24 miles [38.5 km] from Kalbarri on track to gorge, 27°45'S, 114°20'E, 5 Sep. 1963, *A.R. Fairall* 1239 (KPBG); 20 km E of Lake Varley, 32°41'S, 119°35'E, 11 Oct. 1977, *G.J. Keighery* 1090 (KPBG, PERTH); Esperance Bay district, Neridup, c. 3 km NE of Howick Hill, in Location 251, 33°35'S, 122°44'E, 21 Sep. 1968, *A.E. Orchard* 1110 (AD n.v., PERTH); Charles Gardner Reserve, Tammin, 31°38'41"S, 117°28'54"E, 20 July 1993, *L. Sweedman* 2641 (KPBG).

Distribution. Widespread in the South West Botanical Province. The type variant is restricted to the Perth Region on the Swan Coastal Plain. The wheatbelt variant occurs from Dumbleyung north to Kalbarri and east to Esperance. The south coast variant occurs from Denmark, east to Fitzgerald River and north to the Stirling Ranges. (Figure 3C)

Habitat. On the Swan Coastal Plain, recorded as growing in swampy areas in low scrub-heath with *Calectasia narragara*, *Hakea prostrata*, *Philothea spicata* (A. Rich) Paul G. Wilson and *Viminaria*

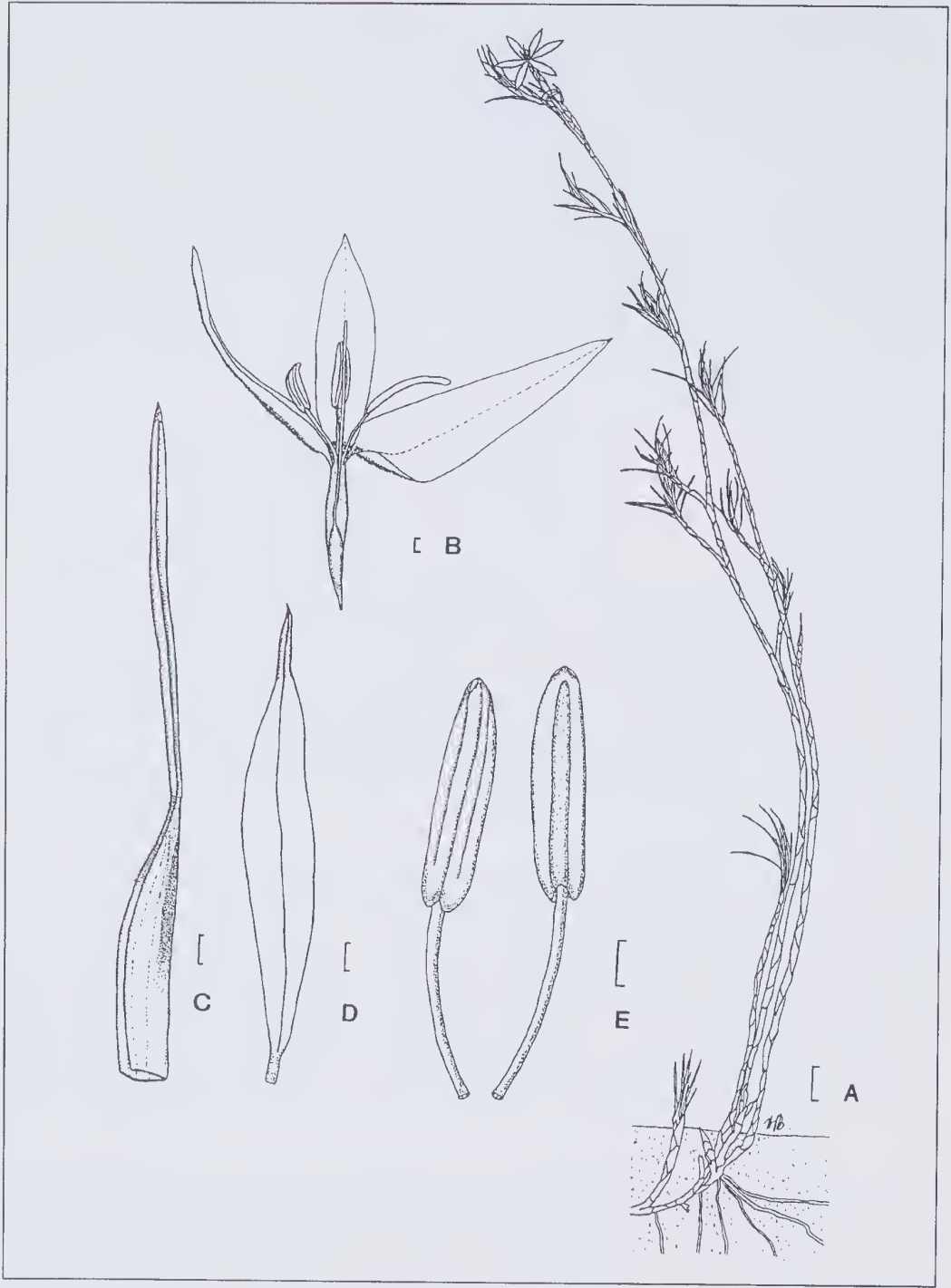


Figure 7. *Calectasia grandiflora* (type variant) A - habit; B - flower (cross-section); C - leaf; D - bract; E - anther (adaxial side L, abaxial side R). Scale bars: A = 1 cm, B-E = 1 mm. A drawn from R.L. Barrett & K.W. Dixon 1379, B-E from G.J. Keighery 6282.

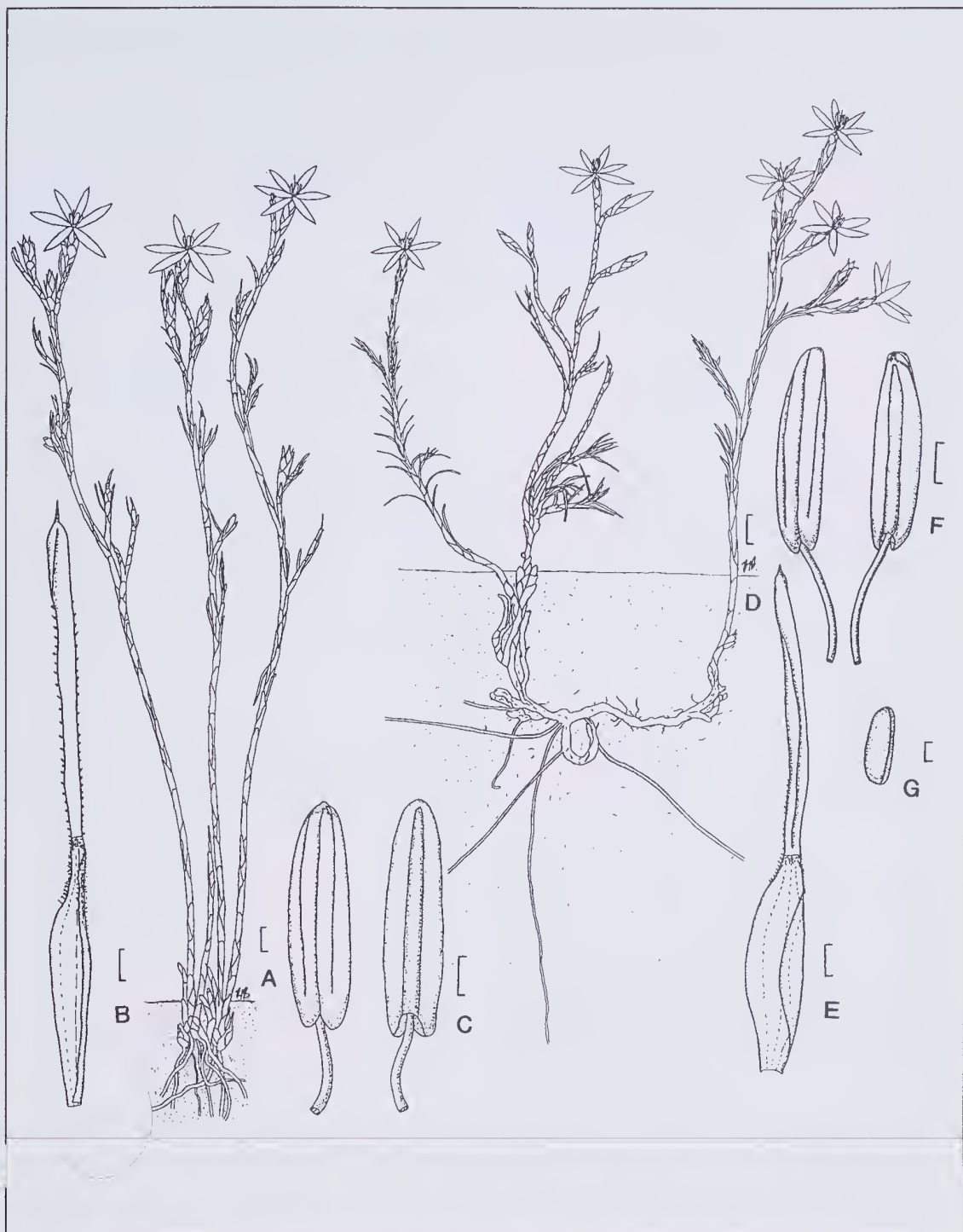


Figure 8. *Calectasia grandiflora* (wheatbelt variant) A - habit; B - leaf; C - anther (adaxial side L, abaxial side R); (south coast variant) D - habit; E - leaf; F - anther (adaxial side L, abaxial side R); G - pollen grain. Scale bars: A, D = 1 cm, B, C, E, F = 1 mm, G = 1 μ m. A drawn from J. Drummond 779, MEL 2064044; B drawn from R.L. Barrett 1333 (KPBG); C drawn from M. Fagg 1039; D-G drawn from R.L. Barrett et al. 1351.

juncea (Schrader & Wendl.) Hoffsgg. In south coastal regions, in sparse woodland or heath on sand with *Agonis* sp., *Allocasuarina* sp., *Eucalyptus* spp., and *Kingia australis*, often near granite outcrops. In the wheatbelt, commonly in shrub mallee heath on white sand or in Eucalypt woodland on loam. Recorded in association with *Allocasuarina pinaster* (C.A. Gardner) L.A.S. Johnson, *Banksia sphaerocarpa* R. Br., *Beaufortia bracteosa* Diels, *B. micrantha* Schauer, *Callitris roei* (Endl.) F. Muell., *Calytrix leschenaultii* (Schauer) Benth., *Dryandra erythrocephala* C.A. Gardner, *Eremaea pauciflora* (Endl.) Druce, *Eucalyptus albida* Maiden & Blakely, *E. tetragona* (R. Br.) F. Muell., *Grevillea cagiana* McGillivray, *Melaleuca pungens* Schauer and *Petrophile ericifolia* R. Br.

Flowering period. (July) August to September in the Perth region, July to October in the wheatbelt and October to November south of the Stirling Ranges.

Cytology. $2n = 18$ for south coast variant (voucher: J.C. Anway 253) recorded by Anway (1969). $2n = 36$ for wheatbelt variant (voucher: G.J. Keighery 1090) recorded by Keighery (1984).

Conservation status. Not under immediate threat. The two non-typical variants are widespread and locally abundant. The typical variant is only known from swampy areas on the Swan Coastal Plain, mostly in reserves within the Perth Metropolitan Region. Further research is required to determine whether this taxon has a broader range than is indicated here. A specimen from Collie (*S. Saunders s.n.* [ACB 38495] (PERTH)) has tentatively been determined as the Type Variant pending further fieldwork.

Etymology. The specific epithet is from the Latin – *grandis* meaning great and – *floris* meaning flower in reference to the large flower size relative to *C. narragara*.

Typification. Three sheets have been found which belong to Preiss' original collection (L 0109478, MEL 247847 and MEL 247848). George (1986) cited the two MEL sheets as isotypes without referring to a holotype or specifying lectotype. MEL 247847 is in the best condition and bears a label with the number '1975' in Preiss' hand. It is here designated as lectotype. L 0109478 bears an identical label and is here considered to be an isolectotype. MEL 247848 bears a similar label in a different hand. The specimens match those on the other two sheets and it is also accepted as an isolectotype. None of the sheets bears any locality data. Preiss (1846) cites the collection location for Herb. Preiss No. 1975 as being in swampy areas near the Darling Range, Perth, 1839. There is another sheet (MEL 2064111) labelled as 'Herb. Preiss 1974' which is a mix of *C. grandiflora* and *C. narragara*. The top centre and bottom left specimens belong to *C. grandiflora* while the remainder are *C. narragara*. There are a further three duplicate sheets of 'Herb. Preiss 1974' at MEL, all of which are *C. narragara*. It is quite possible that the two elements of *C. grandiflora* were part of 'Herb. Preiss 1975' and mistakenly mounted with '1974' in which case they may be regarded as a third isolectotype.

Affinities. Closest to *C. palustris*, differing principally in having a short clumping rhizome rather than stilt roots and similar to *C. intermedia* which has a long decumbent rhizome.

Notes. Commonly called the Blue Tinsel Lily, it is suggested that it should be called the Large-flowered Tinsel Lily to distinguish it from *C. cyanea*. The specimen Cronin *s.n.* has only three perianth lobes per flower though it is otherwise normal.

Three variants appear to be recognizable based on habit and minor floral characters, however further research is required before formal recognition can be made. Polyploidy may have played a role in the

diversification of the *C. grandiflora* complex (G. Keighery pers. comm.). It is interesting to note that the limited cytological work conducted suggests that the south coast variant is diploid and the wheatbelt variant tetraploid.

The type variant occurs only on the Swan Coastal Plain (restricted to small reserves) and has a low clumping habit. The wheatbelt variant is very robust with a compact erect habit. The south coast variant is slender with a low semi-clumping habit, a 'looping' rhizome producing clones at short intervals and very narrow leaves. The wheatbelt variant has a broader, more rounded leaf lamina than the other two variants.

Habit and rhizome structure are the most easily recognizable differences but these are rarely adequately documented on herbarium vouchers and there is insufficient knowledge to determine the boundaries of variation and integration between variants. Plant age is a significant determinant of gross morphology (habit and leaf density), further confusing the situation. Resprouting from a rhizome following fire has been observed for all variants.

Chapman (1991) cites a name '*Calectasia grandiflora* Preiss ex Sonder, *Linnaea* 28: 222 (1856)' [1857]. Preiss (1846) is not cited after the name in the description given by Sonder (1857) although a citation is given for *C. cyanea*. No specimens are cited for *C. grandiflora*, and Chapman gives this name as '*nom. illeg.*' Preiss (1846) is cited in the generic description with direct reference to *C. grandiflora* and the later omission is seen as an oversight. There is no indication that Sonder intended to establish a new name and he was obviously aware of Preiss' earlier publication.

Calectasia hispida R.L. Barrett & K.W. Dixon, *sp. nov.*

Species insignis rhizomate breve et foliis hispidis.

Typus: 28.8 km N of Watheroo Rd on Coalara Rd, Watheroo National Park, Western Australia, 3 July 1999, R.L. Barrett 1295 (*holo*: PERTH 05542472; *iso*: BM, CANB, MEL).

Undershrub without stilt roots, rhizome short, clonal. *Stems* 9–45 cm, with many very short lateral branches. *Leaf* lamina 3.9–10.3 x 0.4–0.7 mm, hispid, margins scabrous; apex acuminate with a pungent mucro 0.4–0.7 mm long; sheath with branched trichomes on margin. *Bracts* 9.5–9.8 x 2.0–2.9 mm, white at base, thin, brown at apex, apex acuminate, margins glabrous. *Perianth* tube 6.8–9.0 mm long, pilose in lower half; throat glabrous, lobes chartaceous, 5.7–12.2 x 2.1–3.5 mm, apex acute, blue, fading to pale blue, pilose on abaxial side. *Staminal filaments* 2.7–3.9 mm long. *Anthers* 3.9–4.7 x 0.9–1.1 mm, apex incurved, yellow, turning orange-red with age, pores below apex-terminal. *Style* 9.0–10.0 mm long, exceeding anthers. *Seeds* not seen. (Figure 9)

Selected specimens examined (10 of 19). WESTERN AUSTRALIA: between road and railway, c. half way between Dongara and Mingenew on Geraldton [Brand] Highway, 29°13'S, 115°11'E, 21 July 1965, J.C. Anway 155 (PERTH); 1.2 km S of intersection of Coorow–Greenhead road on Brand Highway, 50 m NW of rest area, 30°04'11"S, 115°19'52"E, 3 July 1999, R.L. Barrett 1301 (PERTH); Melbourne Loc. 3555, 'Avena Vale', Boundary Rd, 12 km W of Koojan, on W side of property, 30°48'56"S, 115°53'44"S, 4 July 1999, R.L. Barrett 1305 (AD, ALB, BM, CANB, K, KPB, MEL, NSW, PERTH, UWA); 10 miles [16 km] W of Three Springs, 18 Aug. 1968, J.S. Beard 167 (PERTH); Tomkins Rd, 16 km S from Mount Adams Rd intersection, 29°28'09"S, 115°17'42"E, 28 May 1997, R. Davis 3299 (PERTH); Murchison River, *s.d.*, J. Drummond 446 (MEL); 2 miles [3.2 km] along Burma Rd,

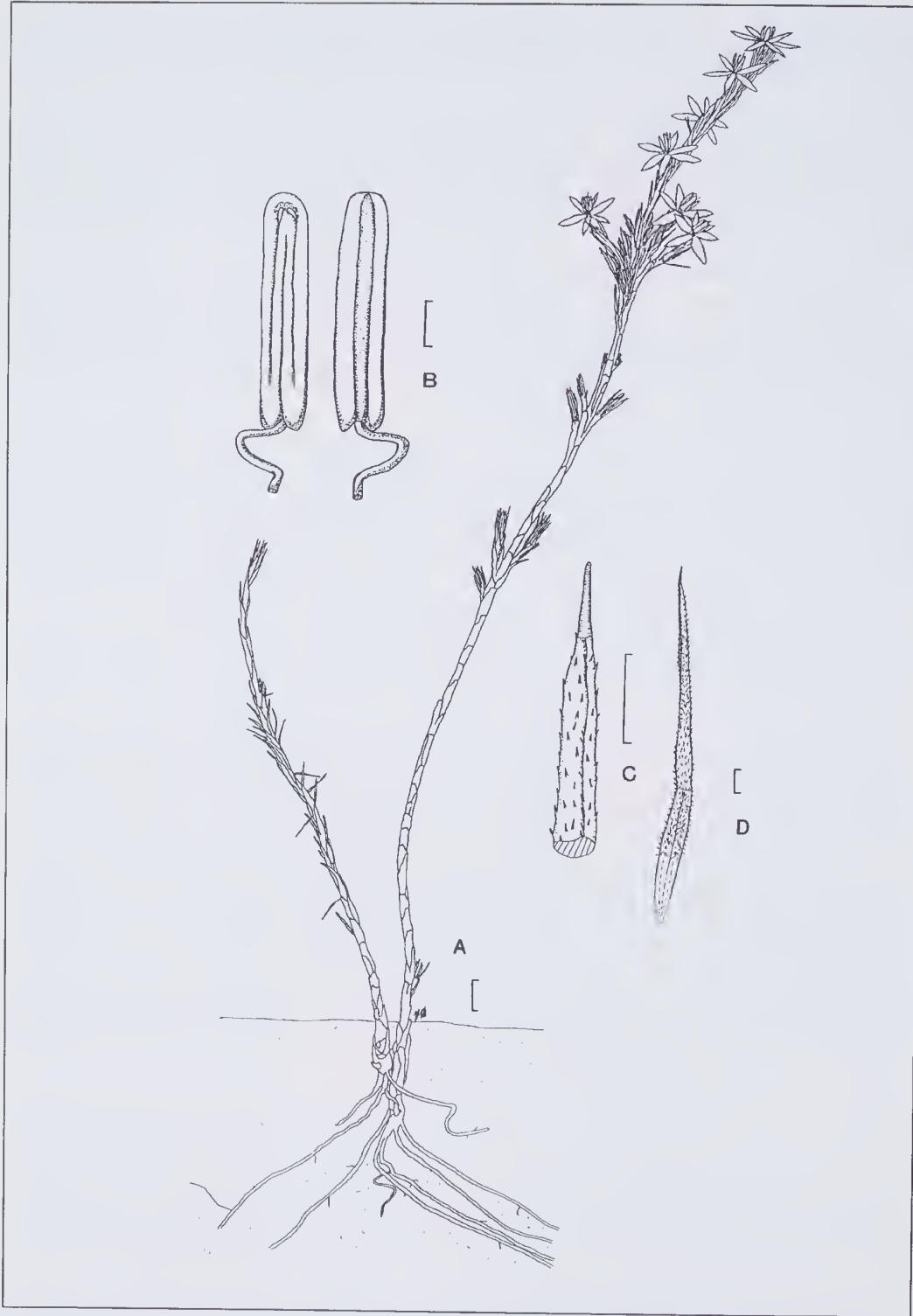


Figure 9. *Calectasia hispida* A – habit; B – anther (adaxial side L, abaxial side R); C – leaf apex; D – leaf. Scale bars: A = 1 cm, B–D = 1 mm. Drawn from R.L. Barrett 1305.

28°55'S, 114°45'E, 30 Aug. 1963, A.R. Fairall 1128 (KPBG); Greenough Flats, 1874, C. Gray s.n. (MEL); 10.3 km along Watheroo Rd from Watheroo, Watheroo National Park, 30°07'S, 115°52'E, 7 May 1984, G.J. Keighery 6856 (PERTH); Geraldton, 1889, H.A. Spalding s.n. (MEL).

Distribution. Relatively common between Gillingarra and Eneabba with an early collection from Kalbarri, in the South West Botanical Province. (Figure 3D)

Habitat. Usually in shallow white/grey sand over laterite on kwongan slopes, occasionally in deeper white sands on flats. Recorded in association with *Acacia pulchella* R. Br., *Banksia sphaerocarpa*, *Cyanostegia corifolia* Munir, *Dryandra lindleyana* Meisn., *Grevillea shuttleworthiana* subsp. *canarina* Olde & Marriott, *Hakea trifurcata* (Smith) R. Br., *Hibbertia huegellii* (Endl.) F. Muell., *Jacksonia restioides* Meisn., *Melaleuca* spp., *Pileanthus filifolius* Meisn., *Ricinocarpos glaucus* Endl., *Stachystemon brachyphyllus* Muell. Arg., *Stirlingia latifolia* (R. Br.) Steud., *Stylidium bulbiferum* Benth. and *Xanthorrhoea preissii* Endl.

Flowering period. May to September.

Conservation status. Not under threat. Common in Watheroo National Park and Alexander Morrison National Park.

Etymology. The specific epithet derived from the Latin – *hispidus*, referring to the hispid indumentum on the leaf lamina.

Affinities. Closest to *C. narragara* differing principally in the hispid leaf lamina and glabrous throat in the perianth.

Notes. The common name of Hispid Tinsel Lily is suggested for this species. Starch is found in the perennating buds also with substantial starch reserves scattered throughout the rhizome, often in multicellular lines. This species has been observed resprouting from a rhizome following fire.

Calectasia intermedia Sonder, *Linnaea* 28: 222 (1857). – *Calectasia cyanea* var. *intermedia* (Sonder) Anway, *Austral. J. Bot.* 17: 158 (1969). *Type:* between the Grampians and Victoria Range, Victoria, November 1853, F. Mueller (*holo:* MEL 247849).

Undershrub without stilt roots, rhizome decumbent, to 50 cm long, buried 7–10 cm deep. *Stems* to 65 cm, with many short lateral branches. *Leaves:* lamina 5.7–16.8 x 0.5–0.8 mm, glabrous, margins scabrous; apex acute with a pungent mucro 0.5–0.6 mm long; sheath with branched trichomes on margin and scattered on lamina. *Bracts* 12.3–13.5 x 2.2–2.8 mm, white at base, thin, brown at apex, pilose in upper third, margins glabrous, apex with vestigial leaf lamina 1.5–2.4 x 0.2–0.4 mm. *Perianth:* tube 10.5–11.6 mm long, golden pilose; throat with short scattered hairs, lobes chartaceous, 13.6–16.7 x 3.2–4.1 mm, apex acute, blue, not fading, pilose on abaxial side. *Staminal filaments* 1.2–1.4 mm long. *Anthers* 4.4–5.0 x 0.8–1.1 mm, yellow, turning yellow-brown, pores terminal. *Style* 7.8–8.5 mm long, exceeding anthers. *Seeds* not seen. $2n = 18$ (Anway 413) *fide* Anway (1969). (Figure 10)

Selected specimens examined (10 of 63). SOUTH AUSTRALIA: c. 18 miles [29 km] SW of Bool Lagoon, SW of Naracoorte, 13 Sep. 1965, J.C. Anway 369 (PERTH).

VICTORIA: junction of Roses Creek Rd and road from Zuinsteins to Halls Gap in the Grampians, 20 Sep. 1965, J.C. Anway 413 (PERTH); Portland, c. 3 miles [4.8 km] N of Greenwald, N side of Crawford

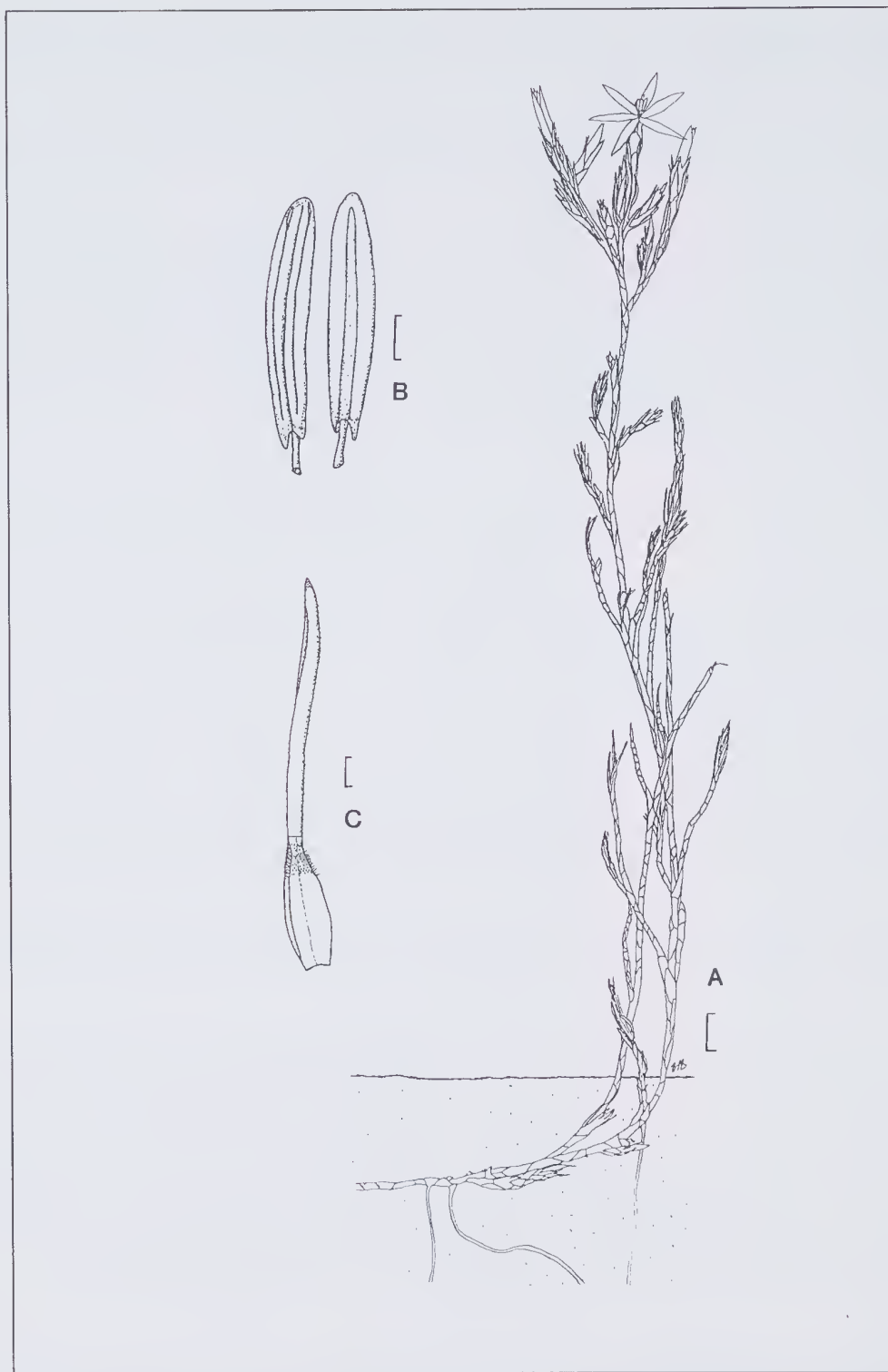


Figure 10. *Calectasia intermedia* A – habit; B – anther (adaxial side L, abaxial side R); C – leaf. Scale bars: A = 1 cm, B, C = 1 mm. A drawn from *unknown s.n.* (MEL 2064065); B, C drawn from A.M. Lyne 484.

River, 30 Oct. 1955, A.C. Beauglehole & L. Aitken ACB 19557 (PERTH); 0.5 miles [0.8 km] S of *Dicksonia* pocket of Little Moleside Creek, Lower Glenelg River, 9 Oct. 1965, A.C. Beauglehole & J.C. Anway 512 (PERTH); Grampians, Geerak track c. 0.5 km S of junction with Victoria Valley Rd, 37°24'S, 142°12'E, 22 Oct. 1978, M.G. Corrick 6105 (PERTH); "Little Desert", 5 miles [8 km] S of Kiata, Oct. 1965, *Hately* & J.C. Anway 511 (PERTH); The Grampians (Gariwerd) National Park, junction of Serra Rd and Henman Track, 37°20'56"S, 142°29'06"E, 6 Nov. 1991, A.M. Lyne 484 (CANB, HO n.v.); Grampians, on Siphon Rd, 0.5 km by road from Victoria Valley Airstrip, 37°11'24"S, 142°19'56"E, 30 Oct. 1998, J. Mant & R. de Kok 38 (CANB); Grampians, Th. Müller s.n. (L); towards Lake Bonney, 40 miles [64 km] from the coast, [34°13'S, 140°27'E], 1895, F. Wehl, s.n. (MEL).

Distribution. From Bordertown, eastern South Australia, east to the Grampians and Little Desert, southwestern Victoria. (Figure 3F)

Habitat. Open Eucalypt woodland on sandy soil in the Grampians, with *Acacia myrtifolia* (Sm.) Muhl. ex Willd., *Leptospermum myrtifolium* A. Cunn. ex DC., *Platylobium obtusangulum* Hook. and in heath in the Little Desert.

Flowering period. September to October.

Conservation status. Sporadic distribution due to clearing of habitat, apparently rare in sandy heaths in South Australia (Jessop & Toelken 1986) though this taxon is not considered to be at risk.

Etymology. The specific epithet is from the Latin – *intermedius*, coming between, referring to the apparent intermediate appearance of the species between *C. cyanea* and *C. grandiflora*.

Affinities. Thought to be closest to *C. keigheryi* and *C. grandiflora*, differing principally in having long decumbent rhizomes.

Notes. The common name of Eastern Tinsel Lily is suggested. Seeds apparently spindle-shaped, c. 5 mm long (Conn 1994).

Calectasia keigheryi R.L. Barrett & K.W. Dixon, *sp. nov.*

Calectasiae intermediae affinis sed antherae apice caudato, rhizomate brevi differt.

Typus: eastern edge of Fitzgerald River National Park [precise locality withheld], Western Australia, 11 January 1979, B. Barnsley 526 (*holo:* CANB 7900759).

Undershrub without stilt roots, rhizome short, clonal. *Stems* to 40 cm, with few short lateral branches. *Leaves:* lamina 6.8–12.3 x 0.5–0.8 mm, glabrous, margins finely scabrous; apex acute with a pungent mucro 0.5–0.9 mm long; sheath with branched trichomes on margin. *Bracts* 7.4–8.3 x 1.2–2.0 mm, straw-coloured, margins glabrous, apex with vestigial leaf lamina 1.0–1.8 x 0.7 mm. *Perianth:* tube 9.3–9.8 mm long, golden, white-golden pilose in lower third; throat glabrous, lobes thinly coriaceous, 8.1–12.5 x 1.3–2.1 mm, apex acuminate, blue, fading white, occasionally red, pilose on abaxial side. *Staminal filaments* 1.2–1.6 mm long. *Anthers* 4.5–5.7 x 0.8–0.9 mm, apex caudate, base constricted with a short skirt, yellow, not turning orange-red with age, pores terminal. *Style* 12.1–12.5 mm long, exceeding anthers. *Seeds* not seen. (Figure 11)

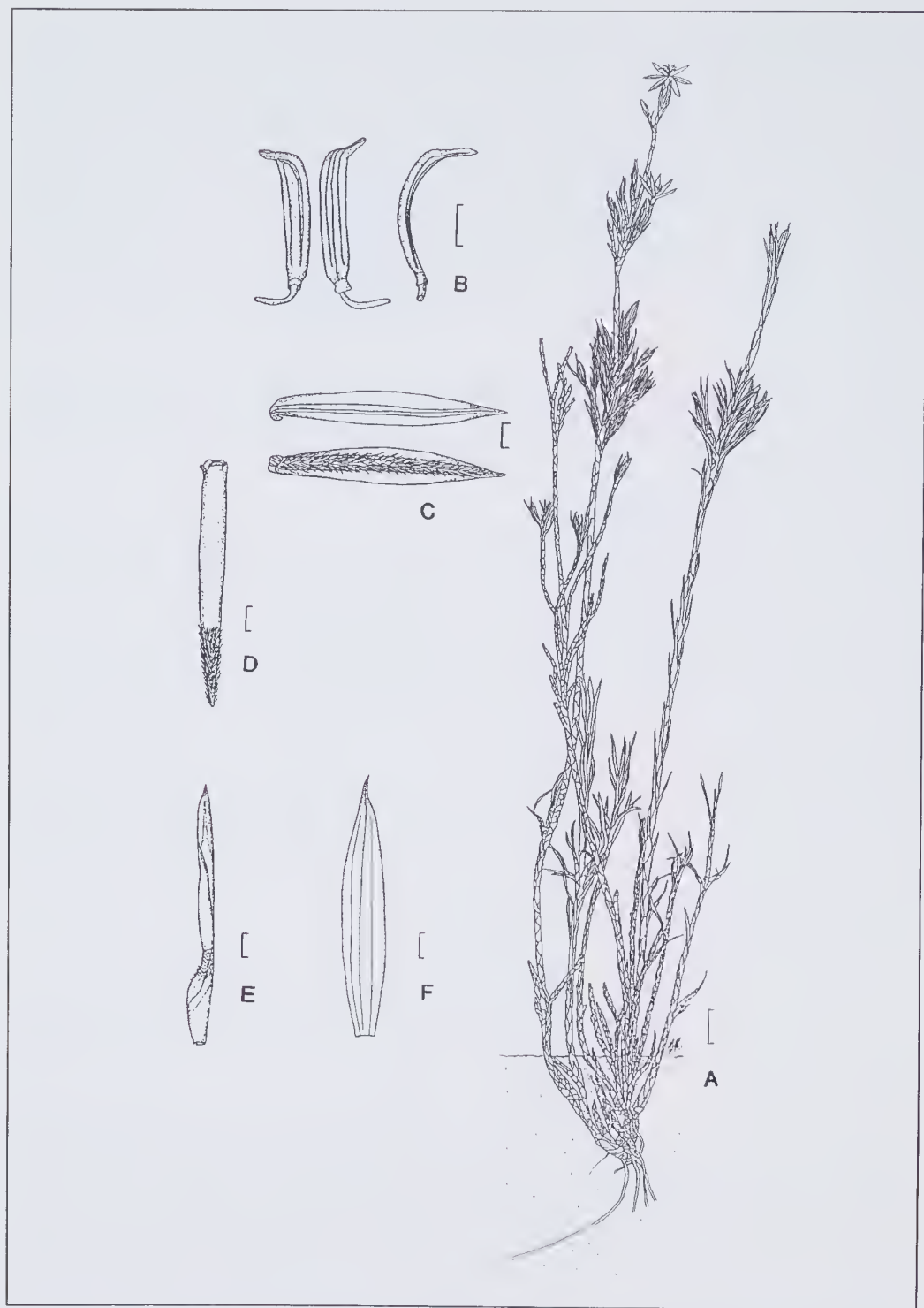


Figure 11. *Calectasia keigheryi* A – habit; B – anther (adaxial side L, abaxial side C, side view R); C – perianth lobes; (adaxial side T, abaxial side B); D – perianth tube; E – leaf; F – bract. Scale bars: A = 1 cm, B–F = 1 mm. Drawn from B. Barnsley 526.

Other specimens examined. WESTERN AUSTRALIA [precise localities withheld]: near West Mount Barren, Sep. 1970, *T.E.H. Aplin* 3803 (PERTH); Near Mount Maxwell, 4 July 2000, *R.L. Barrett* 1384 (KPBG, MEL, PERTH, UWA); *loc. id.*, 19 July 1970, *K.R. Newbey* 3192 (ALB n.v., photocopy PERTH).

Distribution. Known only from three locations in Fitzgerald River National Park, South West Botanical Province. (Figure 3D)

Habitat. In grey sand or shallow sandy loam over laterite, in low heath with *Banksia baueri* R. Br., *B. coccinea* R. Br., *Franklandia fucifolia* R. Br. and *Pimelea physodes* Hook.

Flowering period. July to September. Also recorded for January, but probably as the result of heavy summer rainfall.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Two. IUCN: VUD1. This species is known only from three locations in Fitzgerald River National Park. Collector's notes record abundance as occasional. Surveys are urgently required to determine distribution and abundance.

Etymology. The specific epithet honours botanist Greg Keighery who has made extensive contributions to the taxonomy, biology and conservation of the flora of Western Australia, including *Calectasia*.

Affinities. Closest to *C. intermedia*, differing in the shape of the anthers, a smaller perianth and compact rhizome. Similar in appearance to *C. gracilis*, a stilt-rooting species lacking a rhizome.

Notes. The common name of Keighery's Tinsel Lily is suggested for this species. *C. keigheryi* has been observed to resprout from its rhizome following fire.

This is a very distinctive species with an anther shape unique in the genus. Its small flowers and rhizomatous habit make it easy to differentiate from other species in the region. *C. keigheryi* has golden hairs on the base of the perianth tube, a character otherwise found only in *C. intermedia*.

Calectasia narragara R.L. Barrett & K.W. Dixon, *sp. nov.*

Calectasiae hispidae affinis sed foliis glabris differt.

Typus: Kings Park, near nature trail, 0.5 km W of Roe Memorial, 31°57'44"S, 115°49'59"E, Western Australia, 5 June 1999, *R.L. Barrett & K.W. Dixon* 1306 (*holo:* PERTH 05542618; *iso:* MEL).

Undershrub without stilt roots, rhizome short, clonal, roots clustered, wiry, sand binding. *Stems* to 50 cm, with many short lateral branches. *Leaves:* lamina 4.2–14.5 x 0.4–1.0 mm, glabrous, margins glabrous or scabrous (occasionally pilose), apex obtuse and with a pungent mucro 0.3–0.8 mm long; sheath with branched trichomes on margin. *Bracts* 10.7–12.2 x 1.4–2.1 mm, white at base, papery, brown median stripe in upper half, margins glabrous, apex without vestigial leaf lamina. *Perianth:* tube 8.9–10.2 mm long, pilose in lower half; throat glabrous, lobes chartaceous, 8.7–12.6 x 2.0–3.0 mm, apex acuminate, blue with bronze margins, fading to white, pilose on abaxial side. *Staminal filaments* 1.3–4.2 mm long. *Anthers* 5.1–8.3 x 0.6–1.3 mm, apex incurved, yellow, turning orange-red with age, pores below apex. *Style* 11.4–11.9 mm long, equal to or exceeding anthers. *Seeds* not seen. (Figure 12)

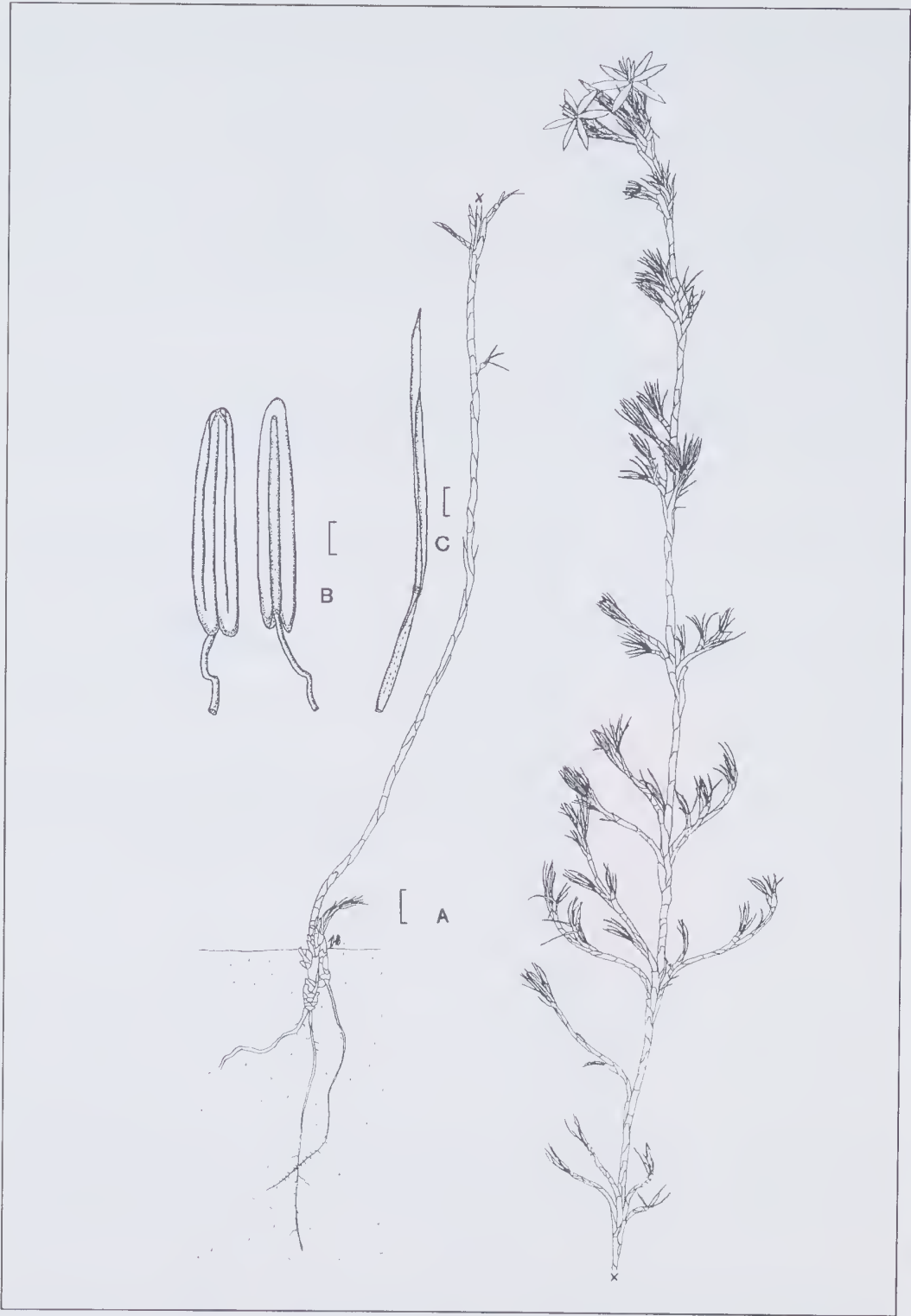


Figure 12. *Calectasia narragara* A – habit; B – anther (adaxial side L, abaxial side R); C – leaf. Scale bars: A = 1 cm, B, C = 1 mm. Drawn from R.L. Barrett & K.W. Dixon 1306.

Selected specimens examined (12 of 174). WESTERN AUSTRALIA: 13 miles [21 km] W of Watheroo on Badgingarra Rd, 20 feet from road, 30°18'S, 115°50'E, 18 July 1965, *J.C. Anway* 148 (PERTH); 6 miles E of Medina about 2 yards S of Highway, 32°14'S, 115°54'E, 5 Aug. 1965, *J.C. Anway* 206 (PERTH); Just off black top 5 miles W of North Dandalup on Mandalup Rd, 32°31'S, 115°53'E, 6 Aug. 1965, *J.C. Anway* 207 (PERTH); 1.7 miles S of Meelon, which is 7 miles SE of Pinjarra, 32°42'S, 115°56'E, 8 Aug. 1965, *J.C. Anway* 214 (PERTH); 1 mile E and 1 m S of Regan's Ford on Moore River on road to Mogumber, 30°59'S, 115°43'E, 12 Aug. 1965, *J.C. Anway* 217 (PERTH); 1.2 km S of intersection of Coorow Greenhead Rd on Brand Highway, 50 m NW of rest area, 30°04'11"S, 115°19'52"E, 3 July 1999, *R.L. Barrett* 1302 (PERTH); Port Augusta, near Geographe Bay, 1881, *D.R. Bunbury s.n.* (MEL); near Swan River, 1839, *J.A.L. Preiss* 1974 (MEL (4 sheets)); 39 km N of Cataby, Brand Highway N of Perth, 30°23'57"S, 115°32'59"E, 2 Sept. 1992, *P.J. Rudall* 37 (PERTH); 82.4 km N of Cataby, Brand Highway N of Perth, 30°04'19"S, 115°23'29"E, 2 Sept. 1992, *P.J. Rudall* 41 (PERTH); 3 km from Bolgart on Pitha Rd, 8 July 1999, *L. Sweedman & K.W. Dixon* 4952 (KPBG, PERTH); Ngarangara, 31°47'S, 115°52'E, 25 June 1957, *C.L. Wilson* 770 (PERTH, UWA).

Distribution. Widespread within 80 km of the coast on the Swan Coastal Plain and Darling Scarp from Busselton north to Geraldton, in the South West Botanical Province. (Figure 3B)

Habitat. Occurring in a wide range of vegetation associations and habitats. In kwongan, recorded with *Allocasuarina humilis*, *Daviesia epiphyllum* Meisn., *Hakea conchifolia* Hook. and *Kingia australis*. In *Banksia attenuata*, *B. menziesii* R. Br. woodland with *Daviesia divaricata* Benth., *Eucalyptus todtiana* and *Hibbertia hypericoides* (DC.) Benth. In *Corymbia calophylla* (Lindl.) K.D. Hill & L.A.S. Johnson, *Eucalyptus marginata* Donn ex Sm. open woodland over *Acacia pulchella* R. Br., *Conostylis setigera* R. Br., *Hakea lissocarpha* R. Br., *Mesomelaena tetragona* (R. Br.) Benth. and *Xanthorrhoea preissii*. In *Allocasuarina* woodland, on white, grey or yellow sand, occasionally on laterite in shallow sand. Occasionally in swampy areas with *Calectasia grandiflora* and *Viminaria juncea*.

Flowering period. (February, March) June to September.

Cytology. 2n = 18 (vouchers: *J.C. Anway* 206, 207, 214, 217), *vide* Anway (1969).

Conservation status. Common, not under threat.

Etymology. *Nar-rag-a-ra* is a composite Nyoongar Aboriginal name for a star (Bindon & Chadwick 1992), chosen for the common name of "Star of Bethlehem" which has often been applied to this species.

Affinities. Related to *C. hispida*, differing as stated under that species.

Notes. This species has been given the common name of "Star of Bethlehem" (often as *C. cyanea*). Starch is found scattered throughout the rhizome in multicellular lines and this species has been observed resprouting from the rhizome following fire.

Calectasia obtusa R.L. Barrett & K.W. Dixon, *sp. nov.*

Calectasiae gracilis affinis sed habito valido, antheris veteribus flavis differt.

Typus: Cape Riche, Western Australia, 24 August 1965, *J.C. Anway* 275 (*holo:* PERTH 01988727).

Undershrub with stilt roots 30–55 mm long; rhizome absent. *Stems* 8–50 cm, with several short lateral branches. *Leaves*: lamina 4.5–8.5 x 0.5–0.9 mm, often appressed to stem, glabrous, apex obtuse, mucro absent (rarely to 0.2 mm), margin with dendritic trichomes; leaf sheath almost glabrous-scattered with short dendritic trichomes, longer on margins. Apical lamina exceeding length of perianth tube by c. 1/2 their length. *Bracts* 9.3–10.9 x 1.3–1.6 mm, pale brown, thin, margins with dendritic trichomes, apex with vestigial leaf lamina 0.8–2.5 x 0.3–0.4 mm. *Perianth*: tube 7.7–8.8 mm long, pilose in lower third and upper one fifth; short tangled barbed hairs in throat, lobes thinly coriaceous, 10.6–13.1 x 3.2–3.5 mm, apex acuminate, margin blue, fading to pale blue, centre wine red, not fading, pilose on abaxial side. *Staminal filaments* 2.7–3.8 mm long. *Anthers* 4.0–4.7 x 1.2–1.3 mm, yellow, not turning orange-red with age, pores terminal. *Style* 9.5–10.8 mm long, exceeding anthers. *Seeds* not seen. (Figure 13)

Other specimens examined. WESTERN AUSTRALIA: c. 7 km N of Cape Riche on Sandalwood Road, 34°34'52"S, 118°43'08"E, 4 Oct. 1999, R.L. Barrett, K.W. Dixon & M.D. Barrett 1345 (AD, ALB, BM, CANB, KPB, MEL, PERTH, UWA); Tieline Rd, between Parker and Moore Dam Roads, Gnowangerup, 33°56'S, 118°00'E, 17 Oct. 1986, E.J. Croxford 4836 (PERTH); S of Twertup Dr., Fitzgerald River National Park, 34°00'S, 119°21'E, 11 July 1970, A.S. George s.n. (PERTH); Bungup North Rd & Newdegate Rd intersection, NW segment, N of drain & S of culvert, 33°17'20"S, 118°53'16"E, 17 Aug. 1995, M.S. Graham MSG 515 (PERTH); Beynon Rd, 30 m N of Magenta Rd, 33°14'40"S, 118°57'55"E, 17 Aug. 1995, M.S. Graham MSG 516 (KNG n.v., PERTH); Gairdner Swamp, 9.6 km NW of Quaalup, 34°12'S, 119°21'E, 20 July 1993, C.W. Hassell H 96 (UWA); Kwoberup [Kwobrup] Rd, 33°37'S, 117°58'E, 28 June 1966, F.W. Humphreys 3 (PERTH); Mission Rd, 20–30 km E of Kojonup, 33°49'05"S, 117°14'20"E, 14 Aug. 1997, C.M. Lewis 248 (PERTH); William River and W of the Blackwood River, s.d., Muir s.n. (MEL); Gordon Inlet Rd, 1 km N of junction between Gordon Inlet Rd and Gairdner River Rd, 34°19'S, 119°24'E, 6 Aug. 1974, G. Perry 187B (PERTH); ?Bremer River, 1884, W. Webb 24 p.p. (MEL).

Distribution. Scattered between Kojonup and Hopetoun, South West Botanical Province. (Figure 3E)

Habitat. In grey clay loam in open woodland with *Dryandra subpinnatifida* C.A. Gardner, *Eucalyptus wandoo* Blakely and *Melaleuca* sp. In low heath over laterite in near coastal areas with *Calectasia gracilis*, *Hakea* spp., *Lambertia* sp. and *Lysinema ciliatum*.

Flowering period. July to August.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Three. While this species has a relatively wide distribution, it is only known from nine populations, two of which are on road verges, comprising two and twelve plants. A third population is recorded as 'several clumps, in open woodland'. Relatively common in the Cape Riche area. As it is a stilt plant relying on seed to recruit following fire, careful management is required to ensure the survival of this species. Further research is required to determine the growth rate of this species.

Etymology. The specific epithet is from the Latin – *obtusus*, referring to the obtuse apex on the leaf lamina.

Affinities. Probably closest to *C. gracilis*, differing in its robust habit and anthers remaining yellow with age. Similar also to *C. palustris*, which has prominently mucronate leaves and grows only in swampy areas of the northern kwongan.

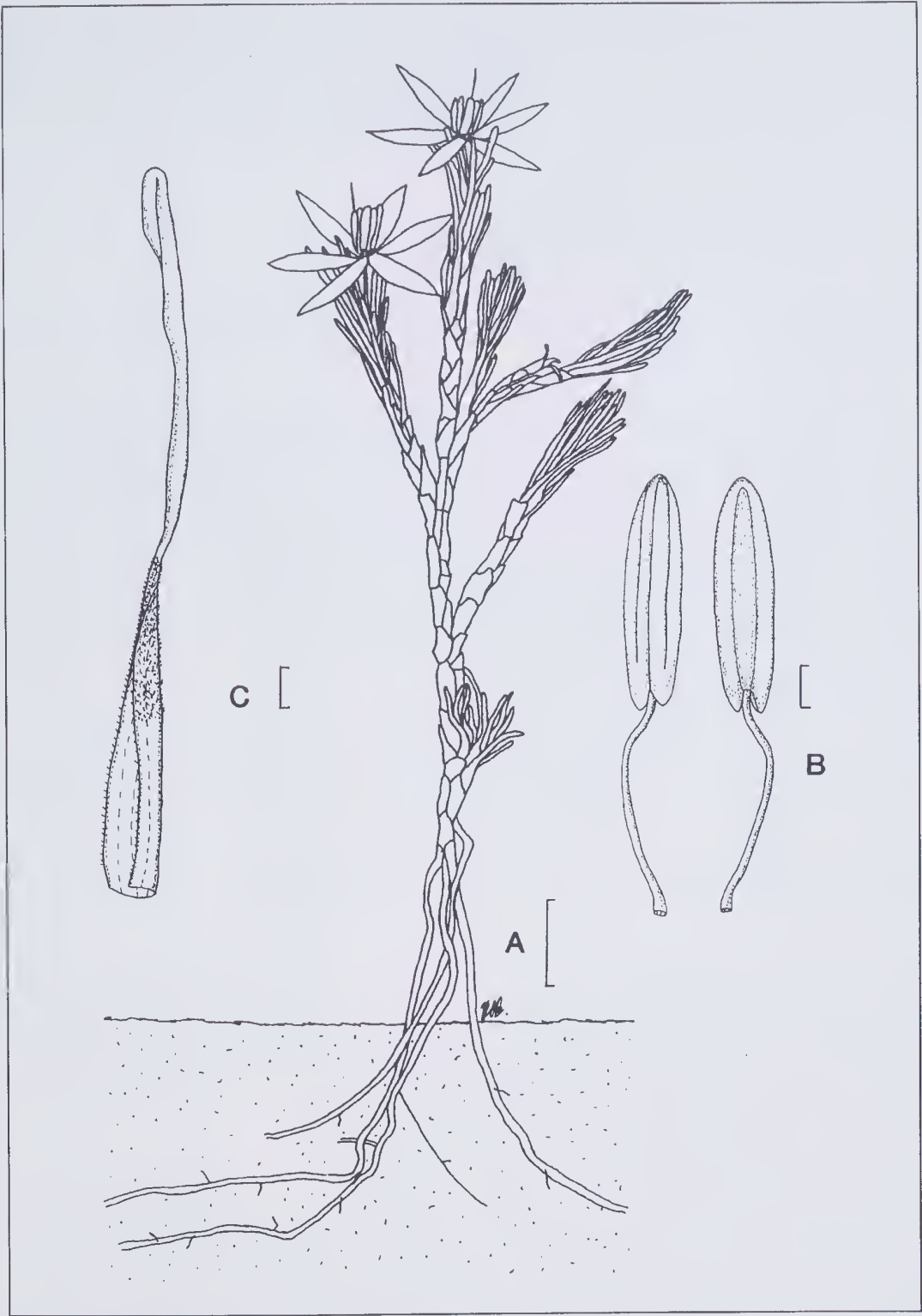


Figure 13. *Calectasia obtusa* A – habit; B – anther (adaxial side L, abaxial side R); C – leaf. Scale bars: A = 1 cm, B, C = 1 mm. Drawn from R.L. Barrett et al. 1345.

Notes. The common name of Blunt-leaved Tinsel Lily is suggested for this species. There are two growth forms for this species, specimens from Cape Riche and the south coast being predominantly 5–15 cm tall with very few branches and specimens from northern populations tending to be 15–35 cm tall with numerous branches. Complete integration has been found inland from Cape Riche with short plants occurring on skeletal stony soils and larger plants occasional in deeper sands.

Calectasia palustris R.L. Barrett & K.W. Dixon, *sp. nov.*

Calectasiae grandiflorae affinis sed rhizomate nullo differt.

Typus: south-west of Badgingarra [precise locality withheld], Western Australia, 30 July 1999, R.L. Barrett 1307 (*holo:* PERTH 05542413; *iso:* AD, ALB, BM, CANB, K, KPBG, L, MEL, PERTH 05542421, UWA).

Undershrub with stilt roots 40–110 mm long; rhizome absent. *Stems* to 70 cm, with many short lateral branches, occasionally with adventitious roots. *Leaves:* lamina 7–23 x 0.4–0.7 mm, glabrous above with short tufted trichomes below, margins scabrous at base, becoming glabrous; apex obtuse with a pungent mucro 0.2 mm long; sheath with branched trichomes on margins. *Bracts* 11.6–13.8 x 1.5–2.1 mm, creamy white, thin, margins glabrous, apex with vestigial leaf lamina 1.6–2.5 x 0.4–0.5 mm. *Perianth:* tube 9.9–10.1 mm long, pilose in lower half and upper eighth; throat with tangle of short hairs, lobes thinly coriaceous, 10.2–12.2 x 1.7–2.1 mm, apex acuminate, blue, fading to red, pilose on abaxial side. *Staminal filaments* 1.0–2.2 mm long, very dark blue. *Anthers* 4.7–5.8 x 0.8–1.1 mm, yellow, not turning orange-red with age, pores terminal. *Style* 10.6–12.0 mm long, exceeding anthers. *Seeds* not seen. (Figure 14)

Other specimens examined. WESTERN AUSTRALIA [precise localities withheld]: type location, 3 July 1999, R.L. Barrett 1303 (KPBG); W of Coorow, 11 Dec. 1999, R.L. Barrett 1378 (KPBG, PERTH); *loc. cit.*, 8 Oct. 1992, E.A. Griffin 7165 (PERTH); *loc. cit.*, 23 Oct. 1992, S. Patrick & A. Brown SP 1389 (PERTH).

Distribution. Known only from two locations 70 km apart, between Cervantes and Coorow, South West Botanical Province. (Figure 3E)

Habitat. Grows in seasonally inundated (0–20 mm) swampland, growing with *Anigozanthos pulcherrimus* Hook., *Banksia ?micrantha* A.S. George, *Byblis gigantea* Lindl., *Calytrix* spp., *Grevillea preissii* Meisn. subsp. *preissii* and *Melaleuca systema* Craven in white sand at the type location, and in *Actinostrobos arenarius* C.A. Gardner scrub with *Banksia leptophylla* A.S. George, *Calytrix flavescens* A. Cunn., *Ecdeiocolea monostachya* F. Muell., *Eremaea beaufortioides* var. *microphylla* Hnatiuk and *Melaleuca seriata* Lindl., in grey sand west of Coorow.

Flowering period. Late July to October.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority One. IUCN: VUD1. The type location is adjacent to a nature reserve however no plants were found in the reserve. No seedlings were found in an adjacent area that had been burnt two years previously. This area is classified as a Dieback Risk Area. Studies are urgently required to determine the effects of dieback on this species. The type population was surveyed in December 1999 and found to consist of c. 120 tussocks in a narrow strip of disturbed sand, mostly 5–10 m from the roadside. The population west

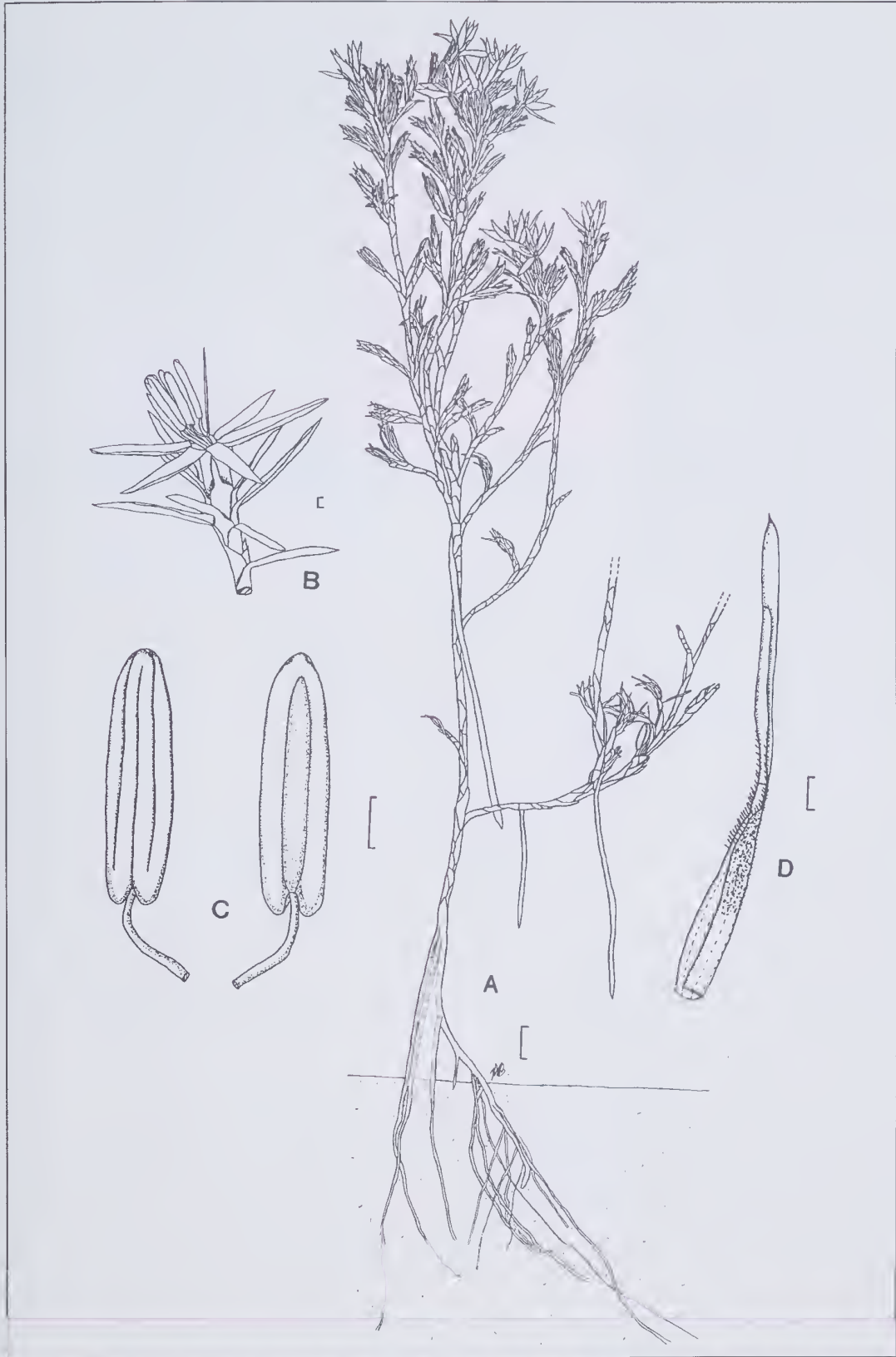


Figure 14. *Calectasia palustris* A – habit; B – flower; C – anther (adaxial side L, abaxial side R); D – leaf. Scale bars: A = 1 cm, B–D = 1 mm. Drawn from R.L. Barrett 1307.

of Coorow is in a nature reserve. It was also surveyed in December 1999 and found to consist of 72 tussocks in an area 10 x 15 m. Each tussock consists of 10–100 ramets. Numerous areas of similar habitat were searched in the vicinity of both locations, however no new populations were found. A third known location west of Coorow (not represented by any collections) was searched but no plants could be located. Further surveys of similar habitats are needed, particularly following fire.

Etymology. The specific epithet is derived from the Latin – *palustria*, meaning swampy, in reference to the unusual habitat preference for this species.

Affinities. Similar in appearance to *C. grandiflora* differing in its stilt-rooting habit, and to *C. obtusa*, differing as stated under that species.

Notes. The common name of Swamp Tinsel Lily is suggested for this species.

There is very minor storage of starch in outer pith of stilt roots and this species is expected to be killed by fire. Old specimens can form large tussocks (Coorow population up to 40 x 60 cm) consisting of up to 100 ramets. The age of these clumps is uncertain, however they are thought to be well in excess of fifty years old.

Calectasia pignattiana K.W. Dixon & R.L. Barrett, *sp. nov.*

Calectasiae cyaneae affinis sed foliis reflexis, staminum filamentis brevis differt.

Typus: near Quairading [precise locality withheld], Western Australia, 20 September 1988, K.W. Dixon 861 (*holo:* PERTH 01730436; *iso:* AD, BM, CANB, MEL).

Rhizome absent, plant with stilt roots 10–60 mm long. *Stems* to 60 cm, slender, with many lateral branches, occasionally with adventitious stilt roots protruding from upper branches (to 150 mm long). *Leaves:* lamina 5.2–11.5 x 0.9–1.4(2.5) mm, glabrous, margins usually glabrous, occasionally slightly scabrous, apex acute and with a pungent mucro 0.4–0.7 mm long; sheath with branched trichomes on margin. *Bracts* 5.9–6.6 x 1.9–2.1 mm, white at base, thin, brown at apex, brown median stripe, margins with branched trichomes, apex with vestigial leaf lamina 1.6–2.1 x 0.2–0.3 mm. *Perianth:* tube 6.2–7.1 mm long, pilose in lower half and in three lines for entire length; short barbed hairs in throat, lobes chartaceous, 6.5–9.0(13) x 1.2–2.0 mm, apex acuminate, dark blue, eventually fading, pilose on abaxial side. *Staminal filaments* 1.1–2.2 mm long. *Anthers* 4.0–5.1 x 0.7–1.0 mm, yellow, turning orange-red with age, pores terminal. *Style* 8.9–9.6 mm long, prominently exceeding anthers. *Seeds* 2.7 x 0.5 mm. (Figure 15)

Selected specimens examined (14 of 22). WESTERN AUSTRALIA: near Toolibin, 28 Oct. 1992, E.M. Bennett 5646 (KPBG); near Quairading, 26 Sept. 1990, R.M. Clifton RMC2 (PERTH); S of Hyden, 19 Nov. 1991, A.M. Coates 3497 (PERTH); Near Lake Wagin, 1895, M. Cronin s.n. (MEL); Sources of Blackwood River, 1889, M. Cronin s.n. (MEL); N of Arthur River, 16 Nov. 1992, V. Crowley & J. Smith s.n. (PERTH); NE of Kukerin, 15 Oct. 1984, E.J. Croxford 3534 (ALB n.v., PERTH); NE of Harrismith, 27 Oct. 1986, E.J. Croxford 5351 (ALB n.v., PERTH); N of Dumbleyung, 3 Dec. 1992, G. Durell GD 18 (PERTH); Between the Swan River and King George Sound, 1881, J. Forrest s.n. (MEL); N of Dumbleyung, 27 Sept. 1975, J.W. Green 4411 (PERTH); Blackwood River, 1876, Miss Hester s.n. (MEL); N of Dumbleyung, 24 Aug. 1985, G.J. Keighery & J.J. Alford 1084 (PERTH); near Toolibin, 16 Dec. 1998, G. Warren SW 00106 (PERTH) [precise localities withheld].

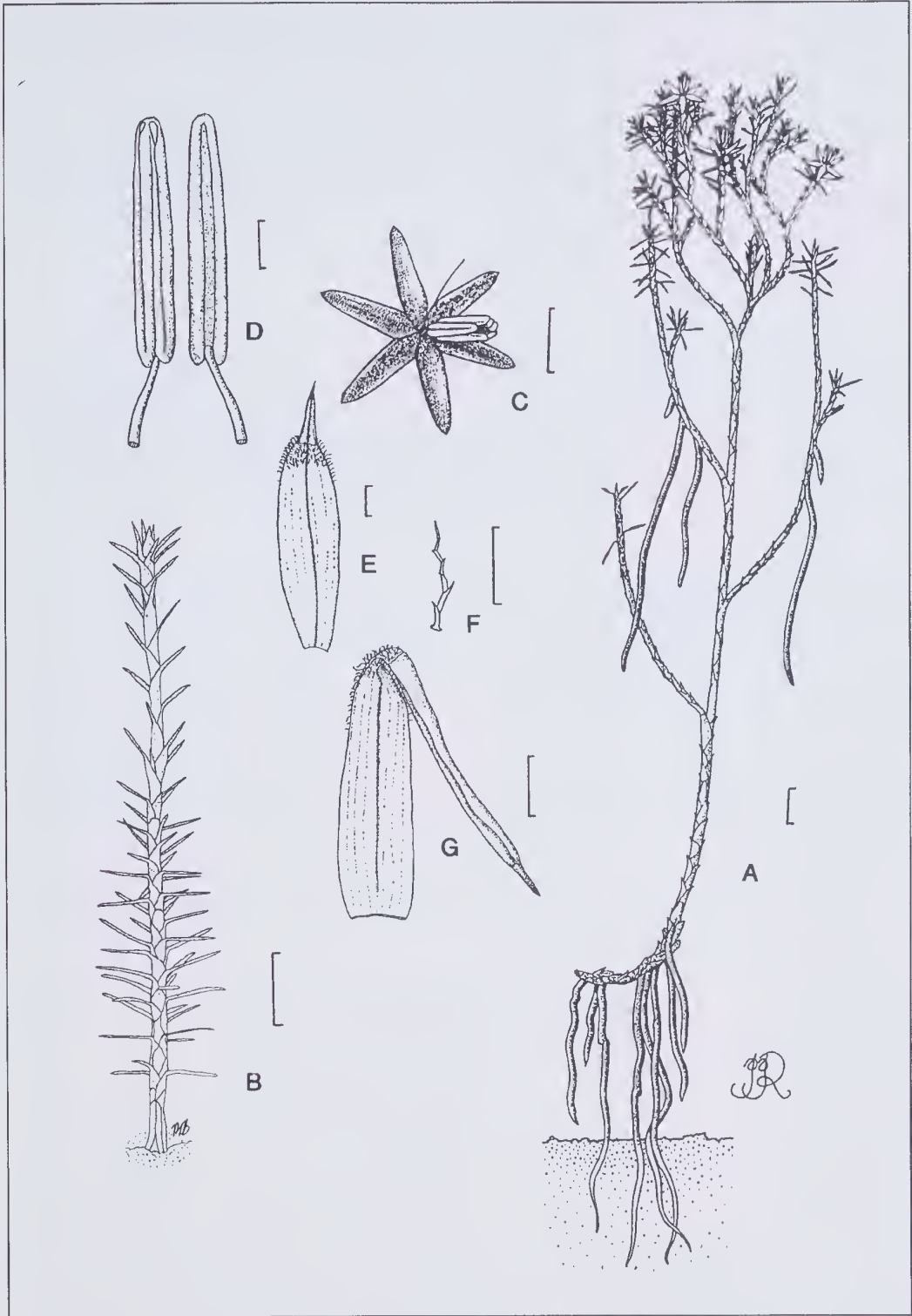


Figure 15. *Calectasia pignattiana* A - habit; B - seedling (3 yrs); C - flower; D - anther (adaxial side L, abaxial side R); E - bract; F - bract hair; G - leaf. Scale bars: A, B = 1 cm, C = 5 mm, D, E, G = 1 mm, F = 0.5 mm. Drawn from K.W. Dixon 861 (A & C drawn by J. Rainbird, B, D-G drawn by RLB).

Distribution. South West Botanical Province. Scattered populations occur between Arthur River, Dumbleyung, Lake Grace and Hyden with a disjunct population near Quairading. (Figure 3A)

Habitat. Yellow sand lenses, in kwongan dominated by Proteaceae. Recorded in association with *Acacia microbotrya* Benth., *Adenanthos* sp., *Allocasuarina humilis*, *Banksia sphaerocarpa*, *B. violacea* C.A. Gardner, *Calothamnus* sp., *Dryandra cuneata* R. Br., *Eremaea pauciflora*, *Hakea trifurcata*, *Kunzea preissiana* Schauer, *Lambertia ilicifolia* Hook., *Leptospermum* sp., *Melaleuca uncinata* R. Br., *Nuytsia floribunda* (Labill.) R. Br. ex Fenzl, *Pericalymma ellipticum* (Endl.) Schauer, *Petrophile longifolia* R. Br. and *Xanthorrhoea preissii*.

Flowering period. June to September.

Conservation status. CALM Conservation Codes for Western Australian Flora: Declared Rare. IUCN: CRC2(a). Ten different locations are known, four of which are on road verges. One site consists of one plant only, a second of three plants while no plants were found at a third site. A fourth site is thought to have been cleared since the original collection was made. The type population near Quairading is under threat from frequent burning (this species is known to be killed by fire) and restricted extent of the preferred soil type. Surveys of all known sites are urgently required to ascertain the extent of current populations.

Etymology. The specific epithet honours Professors Erika and Alessandro Pignatti of Rome on the occasion of their seventieth birthdays. They have contributed greatly to our knowledge of south-west vegetation associations and have collected extensively, including many taxa new to science.

Affinities. Similar to *C. cyanea* and *C. gracilis* but differing as stated under those species. The laminae are also caducous earlier than other species, *K. W. Dixon* 861 (the type) being almost leafless at anthesis.

Notes. This species has been given the common name of Stilted Tinsel Lily. As six stiling species are now known, it is suggested that this species be called Pignatti's Star of Bethlehem. This species has previously been known under the manuscript name of *C. arnoldii* (Brown *et al.* 1998).

The collection *G. Warren* SW 00106 was described by the collector as being rhizomatous, possibly due to young plants not having visible stilt roots (only branches were collected). This site has been visited and plants were found to be stilt-rooted.

Two collections are doubtfully included here (S of Kulin, 28 Aug. 1995, *G. Durell* GD 102 (PERTH); S of Hyden, 20 Sep. 1999, *J. Wege s.n.* (KPBG, PERTH, UWA)). They differ in having larger, non-reflexed leaves and a larger perianth. Further research is required to determine their status.

Acknowledgements

We would like to thank Neville Marchant and staff at PERTH for allowing access to specimens housed at the Western Australian Herbarium and the curators of BM, CANB, L and MEL for arranging loans, especially Roy Vickery (BM), Roslyn Grace (CANB) and Cathryn Coles (MEL). We would also like to thank Luc Willemse (L) for locating specimens at L and Thomas Raus (B) for confirming that no Type specimens are extant at B, and Paul Wilson for the Latin diagnoses.

We would also like to thank Greg Keighery for comments on *C. browneana*, *C. pignattiana*, *C. gracilis* and *C. grandiflora* and the manuscript; Paul Wilson for correcting the Latin diagnoses; Barbara Rye, John Conran and Matt Barrett for comments on the manuscript; Ray Wills for comments on the effects of dieback on Dasypogonaceae *sens. lat.*; Erika and Sandro Pignatti for alerting us to the existence of locations of *C. browneana* and for their enthusiasm in sustaining our interest in *Calectasia*; Juliet Wege (UWA) and Joseph Hartley for collecting material. RB would like to thank Katrina Syme and Brenda Hammersley for hospitality and Erik Veneklaas, Nico Bluethgen and Kirsten Reifenrath for companionship in the field.

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***Sphaerolobium benetectum* (Leguminosae: Mirbelieae), a new species from south-west Western Australia**

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Abstract

Butcher, R. *Sphaerolobium benetectum* (Leguminosae: Mirbelieae), a new species from south-west Western Australia. *Nuytsia* 13(3): 449–455 (2001). A new species of *Sphaerolobium* Sm. that has been collected from three widely spaced locations in the extreme south-west of Western Australia is described and illustrated. *Sphaerolobium benetectum* R. Butcher is one of a group of species possessing a distinctly black-spotted calyx and is most closely related to *S. drummondii* Turcz. and *S. validum* R. Butcher ms. A key to the members of this group is provided.

Introduction

Sphaerolobium Sm. (Leguminosae: Mirbelieae) currently contains 18 named species, 15 of which are endemic to the south-west of Western Australia and occur between Kalbarri in the north and Israelite Bay in the east. The genus shows its greatest species diversity and endemism in seasonally and permanently wet habitats along the south coast between Margaret River and Albany, with two recently described taxa, *S. pubescens* R. Butcher and *S. rostratum* R. Butcher (Butcher 1998), having been identified from within this region. Another new species restricted to seasonally wet habitats of the south-west, but with a wider more scattered range, is described in this paper.

The author is currently performing a cladistic analysis and full revision of the genus and this paper is presented as part of a series dealing with some of the more problematic areas and pressing changes required in the taxonomy of *Sphaerolobium*. The new south-western Australian species is described ahead of the revision because it has a high conservation priority, being known only from three unprotected populations, one of which may already be extinct.

Methods

This study is based on observations of all specimens housed at PERTH as well as photographs of type material for 22 of the 24 names listed in "Australian Plant Name Index" (Chapman 1991) borrowed from M.D. Crisp (Australian National University). In addition to PERTH material, specimens on loan from BM, DNA, G, HO, K, MEL, NSW and P were also seen. Habit and foliage measurement data were

taken from live plants and herbarium specimens and floral characters were taken from fresh material, from plants preserved in 70% ethanol and from reconstituted herbarium specimens.

Taxonomy

Sphaerolobium benetectum* R. Butcher, *sp. nov.

Suffrutices graciles, 0.3–1 m alti; folia alterna ad verticillata, caduca. Flores in axillis foliorum binati. Calyx viridis, atropunctatus, tubo supralabium c. duplo brevior. Corolla luteo-aurantiaca ad rubra, 5.5–6.1 mm longa. Carina angusta obtusata alis longiore. Antherae in sicco dorsaliter prominentibus umbrinis. Stylus leniter curvatus. Alae infra apicem stigmatis longae et angustae (1.2 mm longae, 0.2 mm latae) fimbria marginali longa.

Typus: 7.5 km south-east along Collie–McAlinden road from Collie–Preston road, south of Collie, Western Australia, 12 November 1999, R. Butcher & F. Valton RB 855 (*holo*: PERTH 05541182; *iso*: CANB, MEL, NSW).

Sub-shrub 0.3–1 m tall, up to 0.45 m wide, erect; stems slender, terete. *Stipules* absent. *Leaves* alternate to more or less whorled, sessile, linear to lanceolate, 3–3.5 mm long, 0.3–0.5 mm wide, acute, caducous before flowering. *Inflorescence* of paired, axillary flowers, the leaves caducous, forming a terminal raceme, 50–200 mm long, with 10–100 flowers, flowering basipetal. *Pedicels* 1–1.5 mm long. *Bracts* caducous. *Bracteoles* mid to dark green with irregular black spots over surface, lanceolate, c. 2.2 long, c. 1 mm wide, caducous. *Calyx* mid to dark green with irregular black spots over surface, the spots \pm aggregating at margins of lobes, turbinate, 3.5–4 mm long, the tube c. half as long as the upper lip; upper lip fused along 70–75% of its length, 2.3–2.7 mm long, broadly curved to falcate; lower lobes lanceolate, 2.1–2.6 mm long. *Corolla* yellow-orange and pink to red; standard yellow-orange and red, ovate, 5.1–6.3 mm long, 4.7–5.1 mm wide, including an oblong claw 0.7–0.9 mm long, this with flat to incurved margins and without callosities, the blade entire, slightly auriculate to auriculate, the eye \pm oblong with a flared apex, this with an irregular margin and with a diffuse red surround following veins for a short distance; wings pink-red, oblong, 5–5.5 mm long, 1.8–1.9 mm wide, including a claw 0.6–0.9 mm long, the whole shallowly pouched near spur, the apex of the blade rounded, the adaxial spur angled, 0.5–0.7 mm long; keel yellow and red, longer than the wings, 5.6–6.2 mm long, 2.3–2.6 mm wide, including a narrow claw 1.1–1.3 mm long, the whole pouched parallel to adaxial edge, the apex obtuse, the adaxial edge straight, the spur angled, 0.6–0.8 mm long, the abaxial edge gently arcuate. *Stamens* with filaments 4.5–5 mm long; anthers rotund to oblong, versatile, dorsifixed, 0.4–0.6 mm long, 0.3–0.5 mm wide, oblong appendages prominent on dorsal surface, orange to red on dried specimens. *Gynoecium* 6.5–9 mm long including the stipe (1–1.3 mm long, c. 0.2 mm wide); ovary glabrous, green; style 3–5.2 mm long, gently curving adaxially, with a narrow (1.2–1.4 mm long, c. 0.2 mm wide), densely fringed subapical wing; stigma shortly tufted. *Pod* green when immature, \pm orbicular, compressed obliquely on adaxial surface, c. 2.7 mm long, c. 2.3 mm wide. *Seeds* 2, not seen at maturity. (Figure 1A–I)

Other specimens examined. WESTERN AUSTRALIA: Mt Lindesay 4WD track, c. 3 km due E of Mt Lindesay, NNW of Denmark, 11 Nov. 1998, R. Butcher & J. Chappill RB 667 (PERTH, K); Collie Road South (7.7 km E along McAlinden–Cardiff road), 29 Oct. 1997, R.J. Cranfield 11474 (PERTH); off Mt Lindesay track, Denmark, 6 Nov. 1982, E.J. Croxford 1904 (PERTH); 5 km N of Brennan's Ford along Scott River road, NE of Augusta, 16 Nov. 1982, K.H. Rechinger 59871 (G).

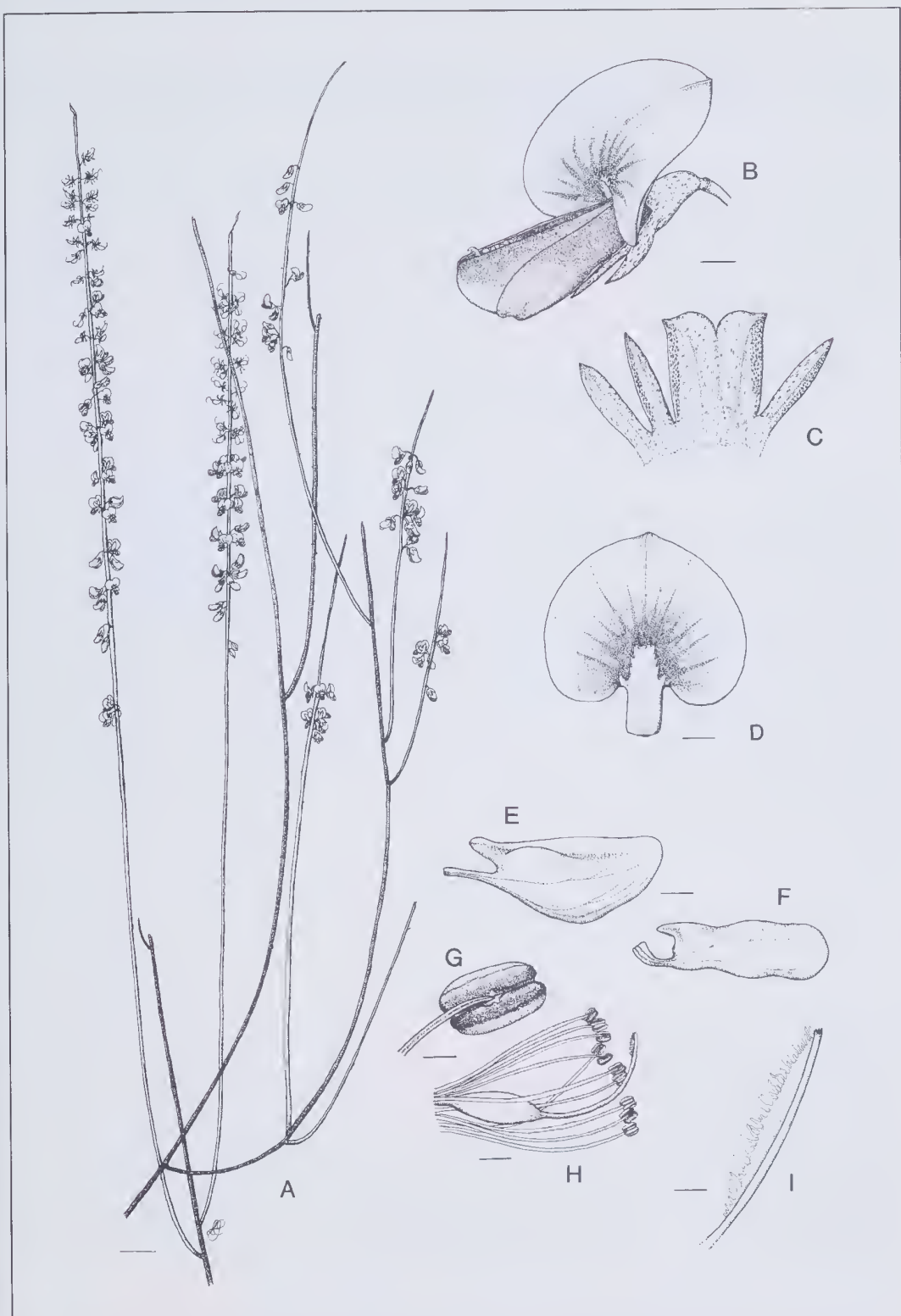


Figure 1. Illustrations of *Sphaerolobium benetectum*. A - habit; B - whole flower; C - calyx; D - standard petal showing roughly oblong eye with irregular margin; E - keel petal; F - wing petal; G - detail of dorsal surface of anther cells showing darker ridges; H - gynoeceium showing gently curved style and anthers; I - detail of elongate sub-stigmatic wing showing long fringing hairs. Scale bars: A = 10 mm; B-F & H = 1 mm; G & I = 0.2 mm. Illustrations taken from R. Butcher & F. Valton RB 855 and drawn by Lorraine Cobb.

Distribution. *Sphaerolobium benetectum* has been found in three disjunct locations in the south-west of Western Australia; just south of Collie, north-east of Augusta and at the base of Mt Lindesay, north-west of Denmark (Figure 2).

Habitat. *Sphaerolobium benetectum* has been collected from low-lying, seasonally wet areas fringing swamps, from grey sandy loam over granite and white-grey to pinkish-light brown gravelly sandy clay. Associated vegetation includes *Eucalyptus* and scattered *Allocasuarina* woodland with a scrub understorey of *Agonis*, *Grevillea*, *Xanthosia rotundifolia*, *Danipiera*, *Sphaerolobium medium*, *S. grandiflorum* and sedge species, as well as low open shrubland at the intergrade between upland *Eucalyptus* woodland and swampland *Agonis* and *Callistemon* thicket.

Phenology. Flowers of *Sphaerolobium benetectum* have been collected in late October and November. Immature fruits have been collected in November.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority One. The three known populations of *Sphaerolobium benetectum* are unprotected and considered potentially threatened, with one possibly already extinct. A survey of the Mt Lindesay population of *S. benetectum* in November 1998 following a January controlled burn of the region found only one plant growing in an unburned depression, although numerous young plants of *S. drummondii* Turcz., *S. medium* R. Br. and *S. grandiflorum* (R. Br.) Benth. were located, suggesting that *S. benetectum* may have low tolerance to fire. Similarly, the large population growing south-east of Collie is located in a swampy area surrounded by *Phytophthora* infected Jarrah/Banksia woodland and, although the susceptibility of *S. benetectum* to die-back is not known, this situation may pose a risk to this population at a later date. Extensive survey of the Scott River Road locality in October and November 1998 failed to relocate the population from which the Rechinger 59871 collection was made, probably due to the high level of vegetation degradation and weed invasion along this road, and it is possible that this population is already extinct. As a consequence of these perceived threats, immediate further survey for *S. benetectum* is recommended.

Etymology. The specific epithet is derived from the Latin words – *bene* and – *tectus* which together mean “well hidden” or “well concealed” in reference to the long period of time in which this taxon remained uncollected and undescribed, as well as the difficulty with which further collections were made due to the cryptic nature of the species.

Affinities. *Sphaerolobium benetectum* has close affinities with a number of species in the genus which possess a mid- to dark-green calyx with black spots over the entire surface, in addition to black spots covering bracts and bracteoles and located along the margins of leaves. A key to the species contained in this group is presented as part of this paper. Within this group, *S. benetectum* is most similar to *S. drummondii* and *S. validum* R. Butcher ms, taxa previously and erroneously included under *S. macranthum* Meisn. (Bentham 1864; Butcher & Chappill in press), in having slightly raised appendages on the dorsal surface of anther cells which are orange to red when specimens are dried and a keel which is straight on the adaxial edge and arcuate on the abaxial edge. Of these two taxa, *S. validum* is more similar to *S. benetectum* as flowers are yellow-orange and red, the sub-apical stylar wing is prominently fringed and the anther appendages are oblong, drying orange to red and visible from the ventral surface of the anther at the apex and base. These two species can be differentiated however by their standard eye, which is stellate in *S. validum* and oblong with slightly irregular edges in *S. benetectum*; the stylar wing, which is narrowly triangular (0.5–0.7 x 0.1–0.2 mm) in *S. validum* and elongate (c. 1.2 x 0.2 mm) in *S. benetectum*, as well as by their habit; *S. validum* is more-or-less woody at the base with very thick, usually short branches whilst *S. benetectum* is more-or-less herbaceous with

slender, long branches. Comparatively, *S. drummondii* can be more easily distinguished from *S. benetectum* as its flowers are orange-red, pink-purple or cream, the standard eye is domed to cordate, the sub-apical stylar wing lacks a fringed margin and the anther appendages are usually pale orange and hastate to rhombic.

Although the keel of *Sphaerolobium benetectum* is straight on the adaxial edge and arcuate on the abaxial edge, the curvature is less pronounced and the apex of the keel is less obtuse in this species than in *S. validum* and *S. drummondii*. In this respect, as well as in its slender stems and floral coloration, *S. benetectum* resembles *S. medium*. These two species can be differentiated however, as *S. medium* has a keel which is more-or-less straight to gently curved on both edges with an acuminate apex, a stellate standard petal eye and a naked style. In its slender stems, *Sphaerolobium benetectum* also resembles *S. vimineum* and *S. fornicatum* Benth., but can be easily differentiated from each of these taxa by the shape of its keel petals; *S. vimineum* has a keel which is broadly curved on both the adaxial and abaxial edges with an obtuse to truncate apex whilst that of *S. fornicatum* is strongly arcuate on the adaxial edge and \pm straight on the abaxial edge, with a broadly obtuse apex.

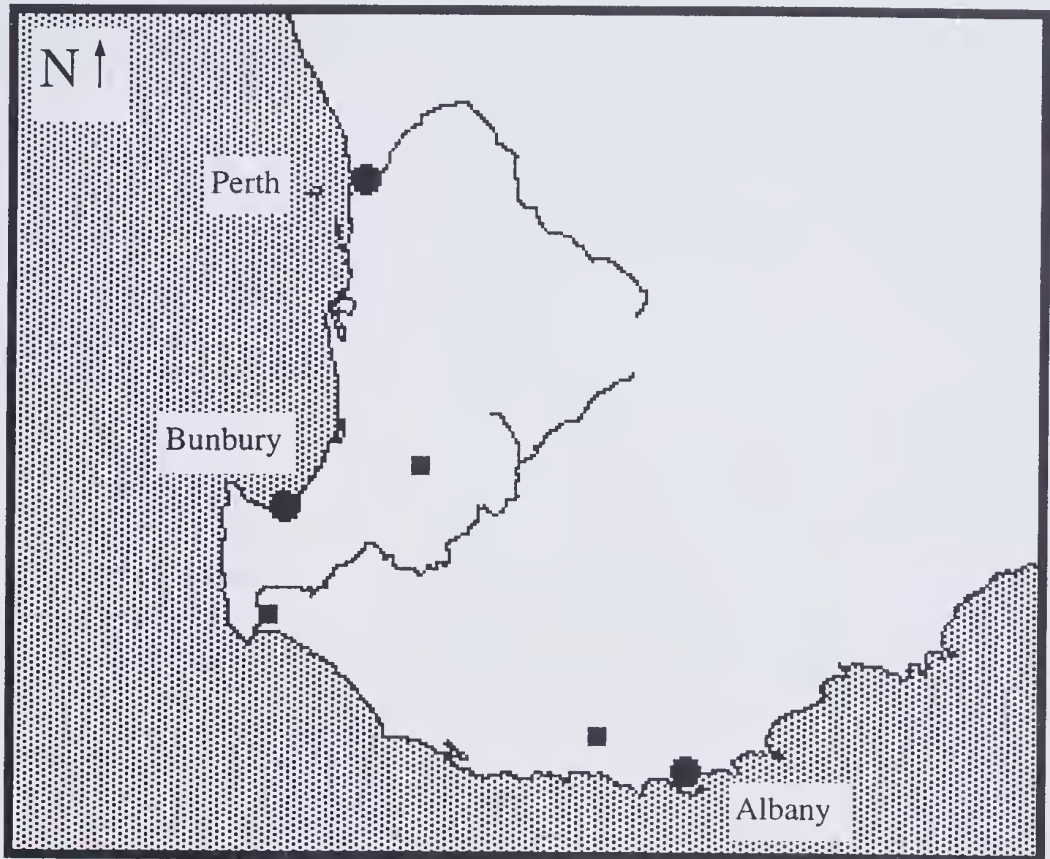


Figure 2. Distribution of *Sphaerolobium benetectum* in the south-west of Western Australia.

Key to *Sphaerolobium* with distinctly black-spotted calces

A complete key for the identification of all *Sphaerolobium* species is still in preparation, but a partial key is presented here to allow the identification of *S. benetectum* and all other taxa in the 'spotted calyx' group.

- 1 Flowers in terminal or lateral racemes, opening from the base (**Group 1 – not included here**)
- 1: Flowers paired in leaf axils, inflorescence racemiform with flowers opening from the apex **Group 2**

Group 2

- 1 Calyx mid to dark green with distinct black spots over entire surface when fresh and dried 2
- 1: Calyx pale green to brown when dried with fine, green to brown spots towards apices of lobes when fresh **alternative not included**
- 2 Calyx tube one-third to three-quarters length of upper lip 3
- 2: Calyx tube c. equal in length to upper lip 6
- 3 Keel petals acute to obtuse, c. equal in length to wings; style with a subapical wing; dorsal surface of anthers with appendages appearing pale orange to red when dried 4
- 3: Keel petals acuminate, longer than the wings; style without a subapical wing; dorsal surface of anthers without orange to red appendages when dried. (Mt Lesueur to Fitzgerald River National Park) **S. medium**
- 4 Styler wing broad (0.3–0.8 mm wide), without a marginal fringe or with a few villi; standard eye domed to cordate; corolla orange-red or pink-purple, occasionally all cream. (Geraldton to Cape Arid National Park) **S. drummondii**
- 4: Styler wing narrow (0.1–0.2 mm wide), fringed; standard eye oblong to stellate; corolla yellow, yellow and red or pink-purple 5
- 5 Branches short and thick; standard emarginate, not auriculate, standard eye stellate; styler wing 0.5–0.7 mm long; stigma prominently tufted. (Bremer Bay to Esperance) **S. validum ms.**
- 5: Branches elongate and slender; standard entire, auriculate, standard eye ± oblong; styler wing 1.2–1.4 mm long; stigma papillose. (Collie, Augusta & Mt Lindesay) **S. benetectum**
- 6 Keel petal apex beaked; calyx without black margin to lobes; ovary yellow with green-brown spots in lower half. (Walpole area) **S. rostratum**
- 6: Keel petal apex obtuse or truncate; calyx usually with black margin to lobes; ovary a uniform colour 7
- 7 Keel strongly geniculate with an erect apex; ovary dark green-brown to black. (Witchcliffe, Walpole to Albany and Stirling Range National Park) **S. grandiflorum**
- 7: Keel gently to broadly arcuate on the adaxial surface with an obtuse apex; ovary pale green or yellow 8
- 8 Standard petal longer than wings and keel; keel petals without red spots; styler wing nearly as broad as long. (Perth to Albany, Fitzgerald River National Park, also New South Wales, South Australia, Victoria and Queensland) **S. vimineum**
- 8: Standard petal shorter than or equal to the keel; keel petals with red spots from apex; styler wing 3–4 times as long as broad. (Perth to Albany) **S. fornicatum**

Acknowledgements

I would especially like to thank Paul Wilson for his considerable help with the Latin component as well as Jenny Chappill for her comments on previous drafts and Mike Crisp from the Australian National University for the loan of type photographs. Illustrations of *Sphaerolobium benetectum* were kindly provided by Lorraine Cobb from the Department of Botany, University of Western Australia. Thanks are also due to CALM, Neville Marchant and the staff and volunteers at PERTH, BM, DNA, G, HO, K, MEL and NSW for provision of herbarium facilities and loan material. Additional thanks for their assistance in locating, or attempting to locate, populations are due to Ray Cranfield, Rob Davis, Ben Hartmann, Mike Hislop, Frederic Valton, Juliet Wege and Dan Wildy. This research was supported by an ABRS grant provided to Dr J. Chappill at University of Western Australia.

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Ficus lilliputiana (Moraceae), a new species from the Kimberley region of Western Australia and the Northern Territory

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Abstract

Dixon, D.J. *Ficus lilliputiana* (Moraceae); a new species from the Kimberley region of Western Australia and the Northern Territory. *Nuytsia* 13(3): 457–464 (2001). *Ficus lilliputiana* D.J. Dixon, a new species in subgenus *Urostigma* sect. *Malvanthera* Corner is described from the East Gardiner District of Western Australia and the Victoria River District of the Northern Territory. This lithophytic species is restricted to the sandstone escarpments around Kununurra and the Keep River National Park. *Ficus lilliputiana* is distinct, being the smallest taxon in the section and the only one to have a prostrate habit. Two forms are recognized, *F. lilliputiana* f. *lilliputiana* and *F. lilliputiana* f. *pilosa* D.J. Dixon, and are differentiated on the basis of the presence or absence of an indumentum. A key to the forms and notes on distribution, ecology, reproduction, conservation status and etymology are provided.

Introduction

The genus *Ficus* L., (Moraceae) has a pan-tropical distribution and is estimated to consist of approximately 750 species worldwide. Thirty-nine species are recorded for Australia in all mainland states except Victoria. The genus is divided into four subgenera, *Ficus*, *Urostigma* (Gasp.) Miq., *Pharmacosycea* Miq., and *Sycomorus* (Gasp.) Miq., which are further subdivided into sections, subsections, series, and subseries (Corner 1959a, b, c, & d). The majority of Australian species occur in the *Ficus* subgen. *Ficus* and *Ficus* subgen. *Urostigma*. The taxa in the *Urostigma* sect. *Malvanthera* are currently being revised (Dixon 1999; Dixon in press; Dixon *et al.* in press) as the Flora treatment of Chew (1989) has proved unworkable.

The species in this section occur in Papua New Guinea and Australia. The Papua New Guinean and eastern Australian species, which are frequently encountered in complex rainforest, are hemi-epiphytic and commonly referred to as strangler figs. The remaining species are lithophytic and are usually associated with deciduous vine thickets on rocky outcrops in western Queensland, the Northern Territory, and Western Australia. One species, *F. brachypoda* (Miq.) Miq., extends into central Australia (Dixon, in review). Wheeler (1992) recorded a prostrate *Ficus* from the Kimberley region of Western Australia. She indicated that it was allied to *Ficus platypoda* (Miq.) A.Cunn. ex Miq. but its taxonomic status required further study. This prostrate fig is here described as a new species, *Ficus lilliputiana*.

Materials and methods

Twenty seven specimens from across the distributional range of *F. lilliputiana* were examined. Descriptions are based on material received on loan from the following Herbaria: AD, CANB, DNA, JCT, NSW, and PERTH. Many of the specimens received were sterile, and if reproductive organs were present they were usually few in number. Measurements of the vegetative and floral organs represent the mean of three organs and are accurate to ± 0.1 mm. Measurements of the vegetative organs were taken from dried material. The syconia were measured from spirited material preserved in 80% ethanol. The species has been seen in its natural habitat.

Taxonomy

Ficus lilliputiana D.J. Dixon, *sp. nov.*

Species affinis *Fico brachypodae* (Miq.) Miq. a quo distinguitur habito prostrato.

Typus: hills to the East of Hidden Valley Caravan Park, Kununurra, 15°46'S, 128°45'E, Western Australia, 18 October 1997, D.J. Dixon PHD423 & I. Champion (*holo*: PERTH; *iso*: BRI, DNA).

Diminutive lithophytic *shrub* to 45 cm high, spreading to 100 cm diam. *Twigs* glabrous or puberulous with ascending hyaline hairs, glabrescent. *Leaves* alternate. *Stipule* 10.0–23.5 mm long; glabrous or puberulous with ascending hyaline hairs, glabrescent. *Petiole* 2.5–16.0 mm long, 0.5–1.5 mm wide, glabrous or puberulous with ascending hyaline hairs. *Lamina* 8.0–66.6 mm long, 6.0–40.5 mm wide, obovate, ovate, oblong, elliptic or narrowly elliptic; base cordate, rounded or obtuse; apex rounded, obtuse or acute; abaxial surface glabrous, or puberulous to pilose with ascending hyaline hairs; adaxial surface glabrous or puberulous to pilose, often with ascending hyaline hairs concentrated around base, glabrescent. *Leaf venation*: basal veins indistinct, 33.0°–90.0°; lateral veins 17–46 pairs, 51.0°–78.0°. *Syconia* spheroid to obloid, 5.4–11.5 mm long, 5.3–13.0 mm diam., yellow, orange, red, purple or maroon, glabrous or minutely puberulous to puberulous with ascending hyaline hairs, glabrescent, sometimes punctate; ostiole triradiate. *Basal bracts* 3, imbricate, caducous or occasionally persistent, glabrous or puberulous to pilose, with ascending hyaline hairs. *Peduncle* 1.0–7.0 mm long, glabrous or puberulous with ascending hyaline hairs. *Interfloral bracts* present. *Female florets* embedded in wall of receptacle, sessile or pedicellate; tepals 3 or 4; stigma simple. *Male florets* interspersed with the female and gall florets, sessile or pedicellate; tepals 3 or 4; anther 1, dehiscence crescentic. *Gall florets* sessile or pedicellate; tepals 3 or 4.

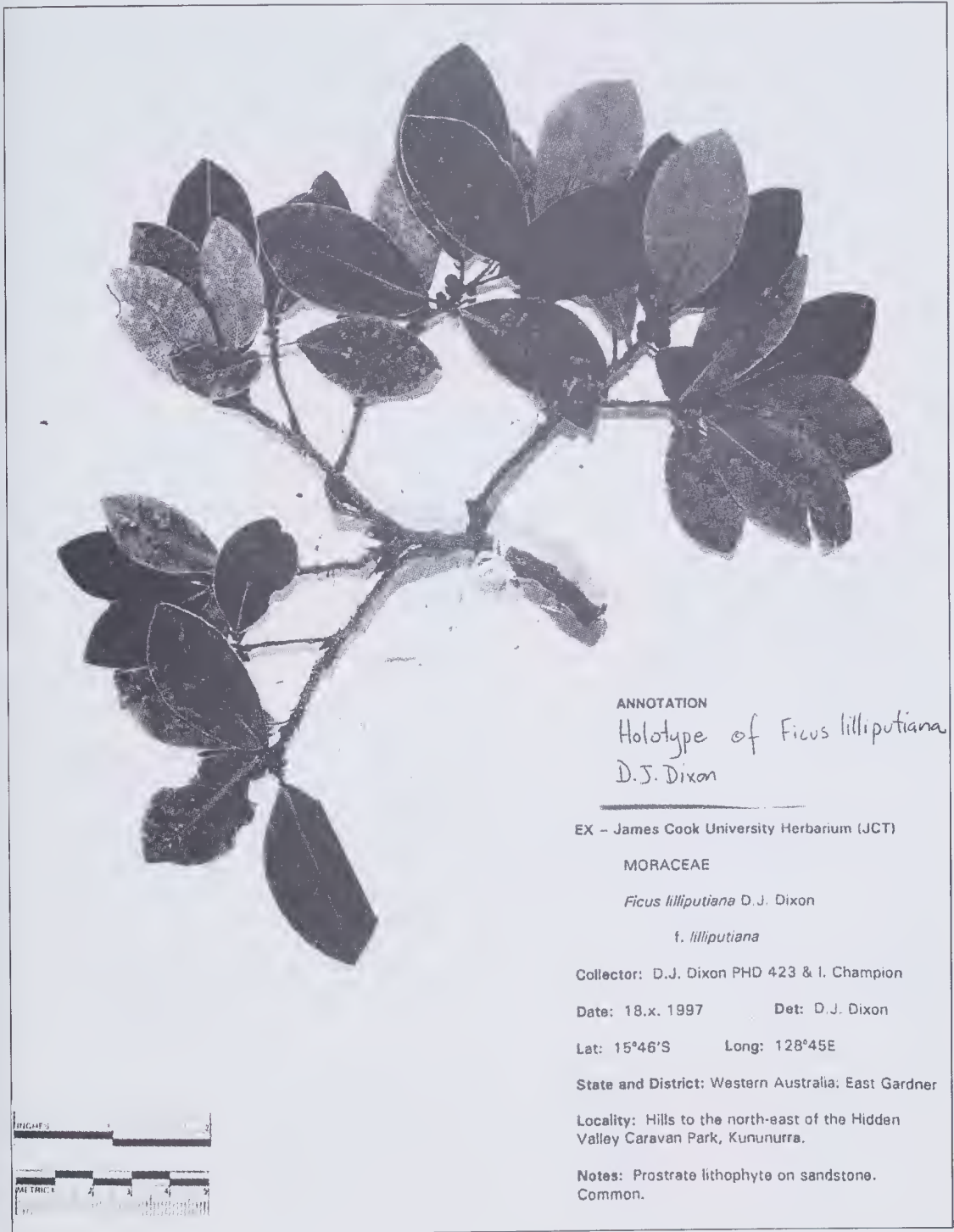
Note. There are two forms, which are distinguished as the key below.

Key to the forms of *Ficus lilliputiana*

- 1. Leaves and other parts glabrous a. *f. lilliputiana*
- 1. Leaves hairy, other parts variously hairy b. *f. pilosa*

a. *Ficus lilliputiana* D.J. Dixon *f. lilliputiana*

All parts glabrous. (Figure 1)



ANNOTATION

Holotype of *Ficus lilliputiana*
D.J. Dixon

EX – James Cook University Herbarium (JCT)

MORACEAE

Ficus lilliputiana D.J. Dixon

f. *lilliputiana*

Collector: D.J. Dixon PHD 423 & I. Champion

Date: 18.x. 1997 Det: D.J. Dixon

Lat: 15°46'S Long: 128°45E

State and District: Western Australia: East Gardner

Locality: Hills to the north-east of the Hidden Valley Caravan Park, Kununurra.

Notes: Prostrate lithophyte on sandstone.
Common.

Figure 1. The holotype of *Ficus lilliputiana*.

Specimens examined. WESTERN AUSTRALIA; EAST GARDNER DISTRICT: Hidden Valley, 3.2 km E of Kununurra, 15°43S, 128°48E, 1 July 1976, A.C. Beauglehole ACB54182 (PERTH); Hidden Valley National Park, Kununurra, 15°45S, 128°45E, 18 July 1988, D.F. Blaxell & J. Wrigley 88/057 (NSW); near Kimberley Research Station, Ord River, 12 Apr. 1958, N.T. Burbidge s.n. (AD); Lake Argyle off access road to Ord River Dam, 16°05S 128°45E, 23 Oct. 1997, D.J. Dixon PHD450 & I. Champion (JCT); hills to the E of Hidden Valley Caravan Park, Kununurra, 15°46S, 128°45E, 18 Oct. 1997, D.J. Dixon PHD420 & I. Champion (JCT); 14.7 km ESE of Kununurra off Victoria Highway, 15°49S, 128°51E, 23 Oct. 1997, D.J. Dixon PHD456 & I. Champion (JCT); Hidden Valley just E of Kununurra, 14°46S, 128°45E, 24 Apr. 1977, A.S. George 14539 (PERTH); Carlton Gorge on Ord River, 15°57S, 128°46E, 21 June 1995, K.F. Kenneally 11624 (PERTH); Hidden Valley, Kununurra, 15°43S, 128°48E, 31 May 1975, P. Ollerenshaw 1677 (CANB); Hidden Valley, near Kununurra, 15°46S, 128°44E, 18 Apr. 1987, R.W. Purdie 3300 (CANB); Hidden Valley, Kununurra, 15°45S, 128°46E, 15 June 1984, M. Rankin 2945 (DNA).

NORTHERN TERRITORY; VICTORIA RIVER DISTRICT: Keep River, 15°47S, 129°02E, 23 Sep. 1975, A.S. Mitchell s.n. (DNA).

b. *Ficus lilliputiana* f. *pilosa* D.J. Dixon, f. nov.

Formas, proxima affinis f. *lilliputianae*, sed ab ea semper differt a puberulis ad trichomata pilosa hyalina praesentibus in foliis.

Typus: hills off the road north-east of Hidden Valley Caravan Park, Kununurra, 15°43S 128°44E, Western Australia, 21 October 1997, D.J. Dixon PHD447 & I. Champion (*holo:* PERTH; *iso:* BRI, DNA).

Leaves with both surfaces of the lamina minutely puberulous to pilose with ascending hyaline hairs. (Figures 2, 3)

Specimens examined. WESTERN AUSTRALIA; EAST GARDNER DISTRICT: Martin's Gap, E of Ord River, 15°37S 128°52E, 14 Apr. 1956, N.T. Burbidge 5156 (CANB); Lake Argyle off access road to Ord River Dam, 16°05S, 128°45E, 23 Oct. 1997, D.J. Dixon PHD449 & I. Champion (JCT); hills to the E of Hidden Valley Caravan Park, Kununurra, 15°46S, 128°45E, 18 Oct. 1997, D.J. Dixon PHD421 & I. Champion (JCT); Hidden Valley, 3.3 km E of Kununurra, 15°47S, 128°46E, 9 Aug. 1981, K.F. Kenneally 7690 (PERTH); Kelly's Knob, Mirima (Hidden Valley) National Park near Kununurra, NE Kimberley, 23 June 1989, K.F. Kenneally 10939 (PERTH); 8 km N of Kununurra, 15°47S, 128°44E, 1 Oct. 1979, Petheram 477 (DNA); Hidden Valley, 15°46S, 128°45E, 22 Aug. 1988, K. Hill 935 (NSW). NORTHERN TERRITORY; VICTORIA RIVER DISTRICT: Gurrandalng Walk, 10 km N of Cockatoo Lagoon, Keep River National Park, 15°53S, 129°03E, 26 June 1984, K.F. Kenneally s.n. (PERTH).

Distribution and ecology. Both forms of *F. lilliputiana* have a limited and totally sympatric distribution (Figure 4). The species is restricted to the sandstone escarpments of the north-eastern Kimberley region of Western Australia and the adjacent Keep River National Park of the Northern Territory. *Ficus lilliputiana* is a lithophyte found growing only in rock crevices (Figure 3). In some cases both forms of this species occur next to one another in the same rock crevice and have been collected and presented as the same herbarium specimen. The PERTH specimen, Kenneally 11624, collected from Carlton Gorge on the Ord River is a mixture of both forms.

Flowering period. Fertile plants have been collected from April to October. However, as further material is collected I expect that reproduction will prove to be continuous throughout the year to support the reproduction of the pollinator wasp.



Figure 2. *Ficus lilliputiana* f. *pilosa*. A – sycones (scale bar 2 mm); B – twig with axillary sycones; C – branch (scale bar 20 mm); D – male floret (scale bar 1 mm); E – female florets (scale bar 1 mm). Drawn by Margaret Menadue from K.F. Kenneally 7690 (PERTH).



Figure 3. Habit of *Ficus lilliputiana* f. *pilosa*. A – on sandstone escarpments of Hidden Valley, east of Kununurra; B – close up of leaves and syconia. Photographs by Kevin Kenneally.

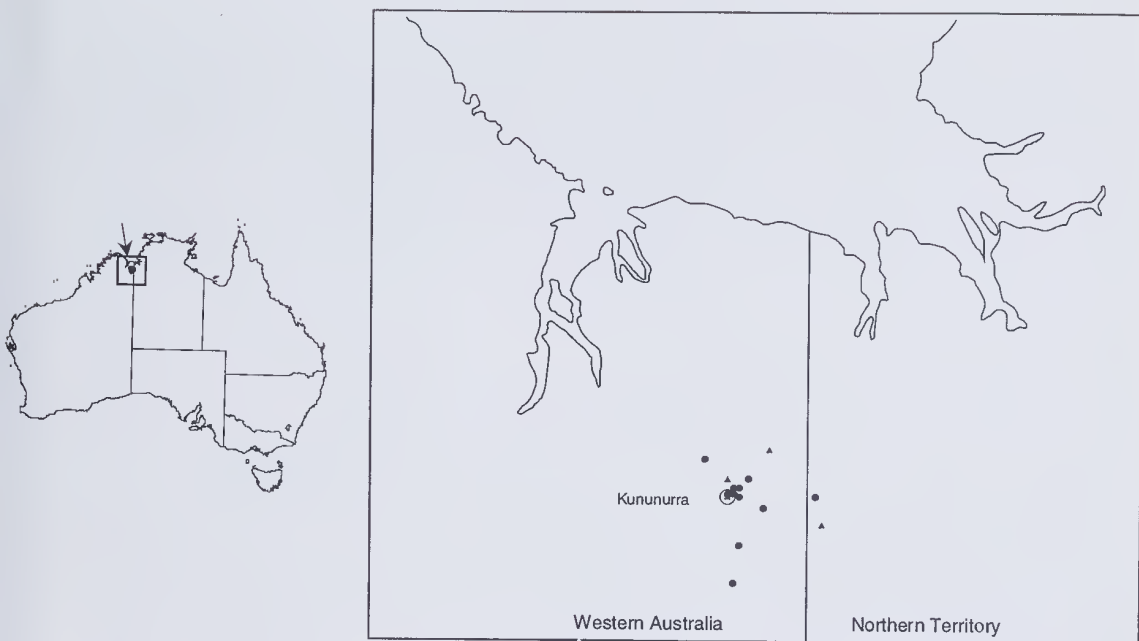


Figure 4. The distribution of *Ficus lilliputiana* f. *lilliputiana* ● and *Ficus lilliputiana* f. *pilosa* ▲ based on available collection data.

Pollination. The pollinator wasp of *Ficus lilliputiana* is *Pleistodontes proximus* Wiebes. *Pleistodontes proximus* was originally described by Wiebes (1990) from wasps recovered from the Kenneally 7690 specimen held at PERTH which had been determined as *F. platypoda*, but which is in fact *F. lilliputiana*.

Conservation status. Both forms are found in national parks in Western Australia (Mirrima), and the Northern Territory (Keep River), however, because of the horticultural appeal of this species, a conservation code of 2RCa is appropriate (Briggs & Leigh 1996). CALM Conservation Codes for Western Australian Flora: Priority Four.

Etymology. The specific epithet – *lilliputiana* alludes to the small growth habit of this species. All other species in subgenus *Urostigma* sect. *Malvanthera*, are erect shrubs or large trees. Stearn (1993) refers to other plant taxa with this epithet as being small enough to inhabit the land of Lilliput in Swift's "Gulliver's Travels". To the Lilliputians, a race of people no taller than six inches (Swift 1726), this fig would have truly been a magnificent banyan. Therefore, I consider *F. lilliputiana* to be a worthy addition to the flora of Lilliput.

The form epithet of *F. lilliputiana* f. *pilosa* is derived from the Latin term – *pilosus*, and refers to the hairs present on both surfaces of the leaves.

Notes. This species is easily recognized in the field as it is the only prostrate species occurring in the subgenus *Urostigma* sect. *Malvanthera*. If collected without reference to its habit, *F. lilliputiana* f. *pilosa* may be confused with *F. brachypoda*. However, it can be distinguished from this species by the absence of ferruginous hairs. *Ficus lilliputiana* has immense horticultural appeal because of its prostrate habit. Lilliput's Fig would be an apt vernacular for this species.

Acknowledgements

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***Verticordia mirabilis* (Myrtaceae: Chamelaucieae), a striking new species
from the Gibson Desert, Western Australia**

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Abstract

George, E.A. and George, A.S. *Verticordia mirabilis* (Myrtaceae: Chamelaucieae), a striking new species from the Gibson Desert, Western Australia. *Nuytsia* 13 (3): 465–469 (2001). *Verticordia mirabilis* Elizabeth A. George & A.S. George (sect. *Integripetala* A.S. George) is described and illustrated. Known from a single locality, it has conservation priority. Together with *V. jamiesonii* F.Muell., which was collected at the same locality, it represents the first record of the genus for the central Australian deserts.

Introduction

The recent collection of two species of *Verticordia* DC. (Myrtaceae) in the Gibson Desert, one a distinctive new species and the other a highly disjunct locality for *V. jamiesonii* F.Muell., is of some phytogeographic interest. There has been no previous record of the genus from the central deserts of Western Australia, although *V. forrestii* F.Muell., *V. serotina* A.S.George, *V. interioris* C.A.Gardner ex A.S.George, *V. helmsii* S.Moore and *V. jamiesonii* occur in the Eremaean Botanical Province, *V. helmsii* growing close to the southern margin of the Great Victoria Desert at Queen Victoria Spring. The genus occurs mainly in south-western Western Australia, in a mediterranean climate, with several species in the monsoonal tropical north and two in the north-west where the rainfall is lower and less reliable. The new species described in this paper, and the outlying population of *V. jamiesonii*, are probably relicts from a wetter period that have adapted to survival in suitable habitats. Several other genera are represented by similar relict species, e.g. *Calytrix*, also of tribe Chamelaucieae (Craven 1987).

Verticordia mirabilis* Elizabeth A. George & A.S. George, *sp. nov.

Verticordiae interiori C.Gardner ex A.S.George affinis, a qua floribus majoribus vinosis, hypanthio obscure 5-costato et tumoribus 5 instructo, sepalis lobis reflexis instructis, petalis non unguiculatis, et stylo longiore, praecipue differt. Flores 20–23 mm diam.; hypanthium 4–5 mm longum; sepala 10–11 mm longa; petala 8–11 mm longa; stylus 16–20 mm longus, barba pilis simplicibus; ovula 6.

Typus: c. 115 km S of Warburton, Western Australia, 8 October 1999, E.A. George 1/99 *et al.* (*holo*: PERTH).

Shrub to 30–60 cm (1 m) tall, bushy and spreading, to 60 cm wide, multi-stemmed from base, divaricately branched. *Leaves* crowded on side branches, semi-terete to triquetrous, thickened upwards, 3–6.5 mm long, concave abaxially, obtuse or with a small mucro, glandular, dull grey-green; margins erose towards apex. *Flowers* few in upper axils, at anthesis 20–23 mm diam. *Peduncles* stout, flared at apex, 2–3 mm long, glandular. *Bracteoles* free, not keeled, not cuspidate, caducous, glandular outside; margins \pm erose. *Hypanthium* turbinate, 5-ribbed, with 5 large swellings below apex, glabrous but glandular, 4–5 mm long. *Sepals* on a broad claw; lamina 10–11 mm long, c. 16 mm wide, deeply fimbriate, with 6–8 primary lobes; primary auricles reflexed over hypanthium, broad, lobed and deeply fringed, pale pink; secondary auricles slender, fringed with a few long hairs. *Petals* shortly united with androecium, 8–11 mm long; lamina ovate, entire or erose, spreading widely, dark burgundy red. *Stamens and staminodes* united for c. 1/3 their length, prominently glandular; stamens 10 fertile, bent outwards; anthers oblong, opening by parallel slits, facing upwards or outwards, 0.8–1.5 mm long; staminodes \pm subulate, slightly exceeding stamens, 4–5 mm long. *Style* 16–20 mm long, with a beard of simple hairs below apex; stigma slightly enlarged, rounded. *Ovules* 6, basally attached. (Figure 1)

Other specimen examined. WESTERN AUSTRALIA: type locality, 13 Sep. 1999, J. Rowley & I. Lyon s.n. (PERTH).

Distribution. Known only from the type locality in the southern Gibson Desert, Western Australia. (Figure 2)

Habitat. Grows on a rocky outcrop in lateritic skeletal soil over sandstone and shale, with tall open shrubland of *Callitris glaucophylla* and *Acacia aneura* and lower shrubs such as *Acacia grasbyi*, *Calytrix*, *Eremophila*, *Ptilotus* and *Dodonaea*.

Flowering period. Flowers September and October. The flowers produce copious nectar.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority One. Known from only the type locality where some 50 plants were recorded.

Etymology. The Latin *mirabilis* refers to the wonder and astonishment of discovering a species of *Verticordia* so far beyond the previously known occurrence of the genus, in a desert habitat.

Notes. This very striking species belongs to subg. *Eperephes* A.S. George and seems best placed in sect. *Integripetala* A.S. George. It necessitates an amendment to the circumscription of the section (George 1991: 279), in particular to include the 5-ribbed hypanthium with large swellings at the top, and the ovary with 6 ovules. Also, the flowers are few in the upper axils, rather than in corymb-like groups, and the style is long-exserted (included in other species of the section). The species of the section are, however, a somewhat disparate group, and further research may result in an amended sectional classification for them.

Verticordia mirabilis differs from the other four species of section *Integripetala* in the five prominent swellings on the hypanthium that superficially resemble the reflexed appendages on the hypanthium in sections *Verticordella* Meisn., *Corynatoca* A.S. George and *Pennuligera* Meisn. The reflexed sepal auricles, very long style and burgundy red flowers also set the new species apart.



Figure 1. *Verticordia mirabilis* A – flowering branch (x1); B – hypanthium showing swellings and ribs (x5); C – part of androecium showing stamens and staminodes (x5); D – style showing subterminal beard (x3). Drawn from E.A.George 2/99 et al. by Margaret Pieroni.



Figure 2. Distribution of *Verticordia* showing the locality of *V. mirabilis* ▼.

Verticordia mirabilis is probably related most closely to *V. interioris* C.A.Gardner ex A.S.George. The latter also occurs in the Eremaean Botanical Province but in the pastoral districts farther west, between Gascoyne Junction and Leonora, and differs especially in its smaller, pink or purplish flowers with a much shorter style.

In the systematic classification of George (1991: 282, 283), *V. mirabilis* would be placed between *V. interioris* and *V. picta* Endl. Another species of this section, the cream-flowered *V. helmsii*, occurs well into the Eremaean Botanical Province as far as Queen Victoria Spring on the southern edge of the Great Victoria Desert.

Another species of Eremaean distribution, *Verticordia jamiesonii*, was collected at the same locality as *V. mirabilis*. This species has previously been recorded from Mt Hale, Mt Narryer, Jingemarra, Kalli and Melangatta Station, some 800 to 900 km west of this locality. The specimens match those of previous collections except in having 6 rather than 8 or 9 ovules (the circumscription of the monotypic section *Jamiesoniana* A.S.George should be amended accordingly).

In the key to species of George (1991), *V. mirabilis* keys out to lead 61b (p. 264), and may then be distinguished as follows:

- 61b (bis) a Flowers red, 20–23 mm diam.; hypanthium 4–5 mm long; sepals 10–11 mm long; petals 8–11 mm long; style 16–20 mm long **V. mirabilis**
- 61b (bis) b Flowers pink, purple or white, 10–14 mm diam.; hypanthium 1.5–2 mm long; sepals 3.5–5.5 mm long; petals 2.5–7 mm long; style 2–4 mm long **couplet 63**

Acknowledgements

The species was discovered by Ian Lyon and Jan Rowley. Margaret Pieroni has provided yet another example of her fine botanical art.

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A new subspecies of *Isotropis cuneifolia* (Fabaceae)

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Abstract

Keighery, G.J. A new subspecies of *Isotropis cuneifolia* (Fabaceae). *Nuytsia* 13(3): 471–474 (2001). *Isotropis cuneifolia* subspecies *glabra* Keighery is described and illustrated. The subspecies is considered endangered, being confined to a small area around Gingin on the Swan Coastal Plain, Western Australia.

Introduction

During intensive floristic and reserve surveys of the Swan Coastal Plain (Gibson *et al.* 1994) it became apparent that a number of taxa present in the area required taxonomic study. This is the third in a series of papers investigating these problems. The first dealt with a new subspecies of *Lambertia echinata* (Keighery 1997) and the second with *Diplopeltis huegelii* (Keighery 1998).

The genus *Isotropis* Benth. (Fabaceae) is well known as the only other group of native legumes producing the poisonous alkaloides, apart from the genus *Gastrolobium* R. Br. The most widespread, and variable member of the genus in southern Western Australia is *Isotropis cuneifolia* (Sm.) B.D. Jacks. (Common Lamb Poison). This species contains populations that are n=6, 12 and 18 and very distinctive morphological races that are currently under study (Keighery unpub. obs.). Gardner & Bennetts (1956) distinguished three different “forma” in their treatment of *Isotropis cuneifolia*. However, these were not formally named according to the International Botanical Code, and have not been used or referred to in the taxonomic literature subsequently. Their “forma *lineata*” ms. was the only one tested experimentally, and proved toxic to sheep.

During surveys of the remnant vegetation of the eastern side of the Swan Coastal Plain, a very distinctive race of *Isotropis cuneifolia* was recorded in *Casuarina obesa* and *Eucalyptus rudis* woodland (Gibson *et al.* 1994). This taxon corresponds with “forma *lineata*”. The author concurs with Gardner & Bennetts (1956) that this is a distinctive taxon that deserves taxonomic recognition.

It is being named to facilitate its listing as a species of conservation interest, as it is confined to a few small remnants. The biology and taxonomy of the rest of the Western Australian members of the genus *Isotropis* is under study.

Taxonomic treatment

***Isotropis cuneifolia* subsp. *glabra* Keighery, subsp. nov.**

Differt a *Isotropis cuneifolia* subsp. *cuneifolia* foliis et ramulis omnino glabris.

Typus: Gingin business road, 6 km south of Gingin, Western Australia, 16 September 1987, G.J. Keighery 9242 (*holo*: PERTH 02869365; *iso*: CANB).

A clonal soft-wooded *shrub*, to 20 cm tall and 2 m across, dying back to the underground stem in summer, and resprouting in winter. *Stem* above ground 2–3 mm wide, glabrous, basal third tinged red, upper shining green. *Basal leaves* sessile (or gradually tapering into a petiole), trident-shaped, distinctly 2-lobed when mature, 76–88 mm long, 8–9 mm across sinus, green, shining, glabrous. *Stipules* 17–23 mm long, green, glabrous. *Pedicels* 80–98 mm long, glabrous. *Bracteoles* immediately below calyx, linear, brown. *Calyx* brown, glabrous, lobes 11–13 mm long, lower lobes obovate-acute, upper lobes two-lobed. *Standard* 26–28 mm wide, eye yellow, surrounded by a red corona then yellow around margins, reverse red. *Wings* 14–17 mm long, red. *Keel* red to almost black. *Ovary* green, densely hairy. *Legume* recurved, cylindrical, 23–30 mm long, narrowed at base into a stipe 5–8 mm long, brown, with scattered appressed hairs. *Seeds* reniform, c. 1 mm wide, brown, surface with an open reticulate pattern. (Figure 1)

Specimens examined. WESTERN AUSTRALIA: Gingin, W.E. Blackall 2962 (PERTH); Gingin, 29 Aug. 1924, Carne & Gardner s.n. (PERTH); 45 mile peg [72 km] on Gingin road, H. Demarz 3928 (PERTH, KPBG); Cowalla Rd, 8 miles [13 km] N of Gingin to Guilderton road, 8 Dec. 1965, A.S. George s.n. (PERTH); Yurine Swamp Nature Reserve, G.J. Keighery 14976 (PERTH); E of Lake Bambun Reserve, 20 Nov. 1991, B.J. Keighery s.n. (PERTH).

Distribution and habitat. Known from the eastern side of the Swan Coastal Plain, extending about 20 km north and south of Gingin, which is 80 km north of Perth. Grows under *Casuarina obesa* or *Eucalyptus rudis* low woodland on winter-wet flats, usually in red clay or ironstone or sandy clay over ironstone. Like other members of this species, plants die down to a persistent rootstock over summer. New stems are produced after the first rains in autumn or winter.

Flowering period. August to October.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Two. One small population is known within a conservation reserve. Other populations are also small.

Notes. This subspecies differs from all other variants of *Isotropis cuneifolia* in being completely glabrous, and in the long, thin shining green leaves. It is separated ecologically from the typical subspecies which grows on well drained sites on the Swan Coastal Plain and adjacent Darling Range. There are three other potential subspecific taxa in the species, occurring between Geraldton and Shark Bay, in the southern wheatbelt and along the south coast.



Figure 1. Flowering branchlet of *Isotropis cuneifolia* subsp. *glabra*. Scale bar = 20 mm. Drawn from G.J. Keighery 14976 (PERTH).

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A new species of *Chamaescilla* (Anthericaceae) from Western Australia

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Abstract

Keighery, G.J. A new species of *Chamaescilla* (Anthericaceae) from Western Australia. *Nuytsia* 13 (3): 475–478 (2001). The genus *Chamaescilla* F. Muell. ex Benth. is currently considered to consist of four species, and a key to these taxa is provided. *Chamaescilla versicolor* (Lindl.) Ostenf. is reinstated and the new species *Chamaescilla gibsonii* Keighery is described.

Introduction

Chamaescilla F. Muell. ex Benth. (Anthericaceae) is a very distinctive small genus endemic to southern Australia. The genus was treated for “Flora of Australia” by Henderson (1986) who recognized two species, one of which had three varieties. However, he noted that the genus required further study and that herbarium collections were often difficult to place. Members of the genus show extensive chromosomal variation (Keighery 1984) and, while they are very distinctive when alive, many herbarium collections of them lack information and parts of the plant most useful for correct placement.

Western Australia is the centre of diversity for the genus and current field studies indicate that at least four species can be recognized in this region. One of these taxa was reduced to a variety (*Chamaescilla corymbosa* var. *latifolia*) by Henderson (1984), but is herein reinstated as a distinct species (*C. versicolor*). A very distinctive species of *Chamaescilla* located in claypans is described herein as a new species.

The taxonomic changes made here are the result of intensive floristic and reserve surveys of the Swan Coastal Plain (Gibson *et al.* 1994; Keighery 1999). This is the fourth in a series of papers investigating taxonomic problems indicated by these surveys. The first dealt with a new subspecies of *Lambertia* (Keighery 1997), the second with *Diplopeltis huegelii* (Keighery 1998) and the third with a new subspecies of *Isotropis* (Keighery 2000).

A key is given to all of the species currently recognized in the genus. Further studies are being undertaken on the variation in *Chamaescilla corymbosa* (R. Br.) F. Muell ex Benth. and the status of the two remaining varieties in that complex.

Taxonomy

Key to the species of *Chamaescilla*

1. Leaves spirally twisted, usually closely appressed to soil *C. spiralis*
1. Leaves not spirally twisted, usually erect and spreading
 2. Each shoot (ramet) with 1 or 2 leaves. Flowers deep blue *C. versicolor*
 2. Each shoot with 5–15 leaves. Flowers pale blue
 3. Inflorescence conic-paniculate, of more than 20 flowers *C. gibsonii*
 3. Inflorescence corymbose-paniculate, of less than 20 flowers *C. corymbosa*

Chamaescilla gibsonii Keighery, *sp. nov.*

Differt a *Chamaescilla spiralis* floribus pallide caeruleis, foliis erectis non spiraliter contortis.

Typus: Waterloo, 33°20'S, 115°45'E, Western Australia, 20 September 1983, *G.J. Keighery* 6837 (*holo*: PERTH 01967029).

Tuberous rhizomatous *herb*, forming dense clumps of 5–12 ramets. *Tubers* numerous, 12–30 mm long, c. 4 mm wide, white. *Leaves* 15–22 per shoot, erect or spreading; sheath hyaline, 30–35 mm long, forming a dense hair-like covering of the rhizome after leaf death; lamina linear-lanceolate, 40–120 mm long, 2–3 mm wide, pale green, not discolorous. *Inflorescence* a dense thyrsoid panicle, 12–26 flowered; scape erect, glabrous, 200–300 mm long. *Pedicels* subtended by 1 or 2 small ovate to triangular bracts. *Perianth segments* spreading, equal, obovate, 6–8 mm long, pale blue, prominently 3-nerved. *Stamens* shorter than perianth segments, anther bright yellow. *Capsule* obcordate, 7–12 mm long, the lobes laterally compressed. (Figure 1)

Selected specimens examined (12 seen, all PERTH). WESTERN AUSTRALIA: 1 mile [1.6 km] S of Mogumber siding, 25 Sep. 1965, *A.S. George* 6839; Waterloo, 20 Oct. 1983, *G.J. Keighery* 6837; Symmonds Block, Tuart forest, SW of Ludlow (33°37'30"S, 115°27'42"E), 15 Sep. 1994, *G.J. Keighery* 13582; Kooljenerrup nature reserve, SW of Pinjarra, 20 Sep. 1995, *G.J. Keighery* 14216; Capel, 24 Sep. 1948, *R.D. Royce* 2688; Muchea, Oct. 1928, *H. Steedman s.n.*

Distribution. Recorded from Mogumber to Busselton on the Swan Coastal Plain.

Habitat and phenology. Occurs in fresh water claypans (vernal pools) usually under *Melaleuca lateritia* or *Melaleuca viminea* shrubland. Like other members of this genus, plants die down to a persistent rootstock over summer. Resprouting occurs after the claypans begin to flood after the heavy winter rains. Flowering occurs when the pans are beginning to dry in spring, but still contain standing water, from September to October. Mature fruits and seeds are found in December.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Three. On the Swan Coastal Plain this species has been recorded from five actual or proposed reserves (Keighery 1999). Although the species is widespread and present in several conservation reserves, most of these populations are small and under a variety of threats.



Figure 1. Photograph of the type plant of *Chamaescilla gibsonii* at Waterloo.

Etymology. The specific name commemorates Neil Gibson, Botanist with the Department of Conservation and Land Management, who has added greatly to our knowledge of the flora of the Swan Coastal Plain.

Notes. This species was previously included under *Chamaescilla spiralis* (Endl.) F. Muell. ex Benth., which is a dryland species, only occurring marginally around wetlands, with dark green spirally twisted leaves that are appressed to the ground, and dark blue flowers. In contrast *C. gibsonii* has pale green straight leaves that are held erect, hence emergent out of the shallow water in which it grows, and pale blue flowers. Plants of *C. gibsonii* form dense clumps unlike the evenly spaced plants found in populations of *C. spiralis*. The two species are geographically separated, with *C. spiralis* occurring in the wheatbelt, ranging from Wongan Hills in the north, south to the Stirling Range, west to Rocky Gully and east to Esperance.

Chamaescilla versicolor (Lindl.) Ostenf., *Kongel. Danske Vidensk. Selsk. Biol. Meddel.* 3: 20 (1921). – *Caesia versicolor* Lindl., *Sketch Veg. Swan River Colony* lvii (1840). – *Caesia corymbosa* var. *versicolor* (Lindl.) Baker, *J. Linn. Soc. Bot.* 15: 361 (1876). *Type:* Swan River, [Western Australia], 1839, J. Drummond s.n. (*holo:* CGE n.v., photo seen).

Caesia spiralis var. *latifolia* F. Muell., *Fragm.* 7: 68 (1870). – *Chamaescilla corymbosa* var. *latifolia* (F. Muell.) R.J.F. Hend., *Fl. Australia* 45: 290 (1987). – *Type:* near Puttingup [near Cranbrook], Western Australia, G. Maxwell (*holo:* MEL).

Distribution and habitat. This species is very widespread on heavy soils in the south-west of Western Australia. Currently the biological survey of the Agricultural zone and Herbarium records show it extending from Kalbarri inland to Morawa south to Perth, south-east to Lake Grace and inland to Merredin.

Conservation Status. This widespread taxon is not considered to be at risk.

Notes. This species was treated as *C. corymbosa* var. *latifolia* by Henderson (1987). However, at Talbot Road Reserve on the eastern side of the Swan Coastal Plain, where both taxa have been recorded (Keighery & Keighery 1993), they coexist without any intergradation. *Chamaescilla corymbosa* occurs on sandy soils in *Banksia* woodland and heathland and *Chamaescilla versicolor* occurs on loams and clay soils in Wandoo woodland, while both occur in Marri woodland on duplex soils.

The taxonomy of the *Chamaescilla corymbosa* complex requires further study. Small plants of this taxon in Western Australia have been named as *Chamaescilla paradoxa* (Endl.) Domin. This name (at variety level) has been attached to the small-flowered variant of *C. corymbosa* by Henderson (1987). This taxon is probably closer to *C. versicolor* and may prove to be the specific name for many Western Australian plants currently referred to *C. corymbosa*, which was named from New South Wales.

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Taxonomic notes on the genus *Johnsonia* (Anthericaceae)

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Abstract

Keighery, G.J. Taxonomic notes on the genus *Johnsonia* (Anthericaceae). *Nuytsia* 13: 479–481 (2001). A new subspecies, *Johnsonia pubescens* subsp. *cygnorum* Keighery, is described from the Swan Coastal Plain, in south-western Australia. New populations are listed for *Johnsonia inconspicua* Keighery, including one very disjunct population with a distinct variant; this species was previously known only from the type collection.

Introduction

Johnsonia R.Br., an endemic Western Australian genus of five species of Anthericaceae, was included in Volume 45 of “Flora of Australia” (Keighery 1987). This paper describes a new taxon that was elucidated during field work on the Swan Coastal Plain for the floristic survey of the region (Gibson *et al.* 1994). New data on the distribution and morphological variation of *Johnsonia inconspicua*, previously only known from the type collection, are also given.

***Johnsonia pubescens* subsp. *cygnorum* Keighery, subsp. nov.**

Differt a subsp. *pubescens* bractae albus cum centralis virides et apex bruneolus, tepala viridi-alba.

Typus: Shire Rubbish Site, 2 km west of Serpentine, Western Australia, 29 September 1982, G.J. Keighery 5249 (*holo:* PERTH 01969501).

Rhizomatous tufted *herb* to 20 cm diameter. *Phylloclades* 30–45 cm long, 1–1.5 mm wide, sparsely pubescent. *Scape* densely pubescent, 10–15 cm long, awned bract 7–10 cm long. *Basal empty bracts* 5–16 mm long. *Floral bracts* narrowly ovate, 17–23 mm long, acute, white with central green stripes and fawn apex, sparsely pubescent to almost glabrous abaxially, margins finely ciliate. *Bracteoles* linear, c. 5 mm long, white. *Flowers* greenish-white. *Tepals* c. 6 mm long. *Anthers* c. 3 mm long, yellow. *Style* c. 4 mm long.

Other collections examined. WESTERN AUSTRALIA: Lowlands Property, 9 km WNW of Serpentine, 13 Aug. 1992, B.J. Keighery & G.J. Keighery 17 (PERTH); Lowlands Property, 9 km WNW of Serpentine, 12 Sep. 1992, B.J. Keighery & N. Gibson 739 (PERTH); Cardup Nature Reserve, R.H. Underwood 49/88 (PERTH).

Distribution and habitat. Grows on white sands often overlying clays in Jarrah (*Eucalyptus marginata*) over *Banksia* low woodland or Jarrah low woodland on the Ridge Hill Shelf geomorphic unit of the Swan Coastal Plain. Also collected from an outlier of Bassendean sands over alluvials on the Serpentine River.

Phenology. Flowering from September to November.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Two. The taxon is very localized in distribution, in the Shire of Serpentine–Jarrahdale over a range of c. 40 km. Although the area is over 90% cleared, extensive survey has recorded populations at Lowlands Private Bushland (Keighery *et al.* 1995), a local Government reserve at Brickwood (Keighery & Keighery 1993a) and Cardup Nature Reserve (Keighery & Keighery 1993b).

Etymology. The epithet is from the Latin *cygnus* – swan, a reference to the Swan Coastal Plain, where this species occurs.

Notes. This very distinct subspecies of *Johnsonia pubescens* is found on the southern margin of the species range. There is a disjunction between the southernmost populations of subsp. *pubescens* at Canning Vale (32°04'S, 115°58'E) and the northernmost populations of subsp. *cygnorum* at Brickwood Bushland (32°18'S, 116°00'E). Subsp. *cygnorum* can be immediately distinguished from subsp. *pubescens* in having white floral bracts with a central green and fawn stripe and greenish flowers rather than white bracts with a central pink flush and pink/purple flowers. The new subspecies tends to be a larger plant than the typical subspecies, with thinner phylloclades and a narrowly cylindrical inflorescence at flowering (subsp. *pubescens* has bracts that open widely during flowering giving the inflorescence an ovoid shape). It was referred to as *Johnsonia* species A in the "Flora of the Perth Region" (Macfarlane 1987), however, at that time it was combined with the other species with a narrowly cylindrical inflorescence, *Johnsonia inconspicua* Keighery.

Notes on *Johnsonia inconspicua* Keighery

In Keighery (1987) this species was only known from the type locality. Subsequent surveys in the area located another two areas of occurrence. One of these is in a local Government Reserve (No. 20418) and the other is a large population, comprising several sub-populations, in road/rail reserves adjacent to (and extending marginally into) Yelverton State Forest.

In 1990 E.A. Griffin collected an unusual specimen of *Johnsonia* in fruit in Julimar State Forest (now Julimar Conservation Park) that he provisionally placed in *Johnsonia inconspicua*. In 1999 this population was relocated in flower, confirming that it is indeed a variant of *Johnsonia inconspicua*, some 300 km north of the southern populations.

This highly disjunct population differs in having flowers with a central purple stripe and the style longer than the anthers with the inflorescences displayed above the leaves. It would appear to be an outbreeding variant of this normally inbreeding species. While these are minor morphological differences a genetic study of the two variants could be illuminating.

Collections examined. WESTERN AUSTRALIA: intersection of Metricup and Metricup–Yelverton roads, Reserve No. 20418, 8 Nov. 1989, *G.J. Keighery* 11125 (PERTH); 3 km along Blythe Rd from Abbey farm road, in rail reserve adjacent to Yelverton State Forest, 8 Nov. 1989, *G.J. Keighery* 10969 (PERTH); Bottom of Blythe Road, Yelverton Forest, 8 Nov. 1989, *G.J. Keighery* 11043 (PERTH); Julimar Forest, Whittaker Rd, 16 Nov. 1990, *E.A. Griffin* 6238 (PERTH); Julimar Forest, Whittaker Rd, 11 Oct. 1999, *G.J. Keighery & N. Gibson* 2886 (PERTH).

Conservation status. CALM Conservation Codes for Western Australian Flora: Reassessed to Priority Three. The southern populations would be relatively secure if the road/rail reserve beside Yelverton Forest were added to this area. The northern population is in Julimar Conservation Park.

Acknowledgements

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***Acacia stellaticeps* (Fabaceae: Mimosoideae), a new species from the Pilbara, Western Australia, to Tanami, Northern Territory**

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Abstract

Kodela, P.G., Tindale, M.D. and Keith, D.A. *Acacia stellaticeps* (Fabaceae: Mimosoideae), a new species from the Pilbara, Western Australia, to Tanami, Northern Territory. *Nuytsia* 13(3): 483–486 (2001). *Acacia stellaticeps* Kodela, Tindale & D. Keith, a new species of *Acacia* section *Plurinerves* (Benth.) Maiden & Betche from Western Australia and the Northern Territory, is described and illustrated.

Introduction

Acacia stellaticeps is a new species of *Acacia* section *Plurinerves* (Benth.) Maiden & Betche (Fabaceae: Mimosoideae) from Western Australia and the Northern Territory. It was previously confused with *A. translucens* A. Cunn. ex Hook. and belongs to the informal '*A. stigmatophylla* group' (see Tindale 1980). *Acacia stellaticeps* is conspecific with *A. translucens* var. *humilis*, however the specific epithet *humilis* could not be used for this new species as it is already occupied by *A. humilis* Schlecht., *Linnaea* 12: 567 (1838).

New species

Acacia stellaticeps* Kodela, Tindale & D. Keith, *sp. nov.

Acacia stellaticeps Kodela, Tindale & D. Keith differt praecipue ab *A. translucens* in capitulo florum gemmis prominentibus late effusis magnis, petalis striatis et phyllodiis mucrone plus minusve erecto gongylo vel conico.

Typus: c. 19 km south-south-east of Sturt Creek on Tanami Track, Western Australia, 14 July 1974, A.C. Beaglehole 47444 & G.W. Carr 3666 (*holo*: NSW; *iso*: DNA, MEL *n.v.*, PERTH *n.v.*).

Acacia translucens var. *humilis* Benth., *London J. Bot.* 1: 364 (1842). Type: Bay of Rest, north-west coast, Western Australia, February 1818, A. Cunningham 115 (holo: K, photo NSW).

Rounded or flat-topped, glabrous, resinous shrub to 2 m high and to 3 m wide, often growing as a low spreading, dense shrub. Bark smooth, later splitting irregularly (fissured), grey or dark grey. Branchlets angular towards apices, pale green, brown or yellowish; ridges resin-crenulated. Phyllodes elliptic-obovate to narrowly elliptic-obovate or sometimes semi-orbicular, oblique, \pm straight to slightly curved and often slightly sigmoid or asymmetrical (the upper margin usually more rounded convex than the slightly convex to shallowly concave lower margin), (0.5)0.8–2(2.5) cm long, (3)4–10(14) mm wide, rigid, often subglaucous but bright green when young, finely longitudinally wrinkled when dry, usually the midvein and often one lateral vein either side faintly visible but often not reaching the apex, the minor veins obscure or not evident, with minor anastomosing sometimes visible, the apex acute to broadly obtuse with a small knob-like mucro; basal gland minute, to 2 mm above pulvinus; pulvinus to c. 1 mm long. Inflorescences simple, single in axils of phyllodes; peduncles 5–30 mm long; heads globular, (5)7–11(15) mm diam., 7–25(35)-flowered, golden; bracteoles to 1.1 mm long, with a \pm peltate, shortly \pm triangular lamina to 0.6 mm wide, or appearing \pm spatulate; buds spreading widely, sometimes smaller and more compact in eastern part of distribution range. Flowers 5-merous; calyx cupular, 0.7–1.1 mm long, barely dissected, often scurfy at apices; corolla usually three or more times longer than calyx (rarely about twice as long), (1.5)2.4–3.5 mm long, dissected by 1/2–2/3, the petals striated, reddish tinged inside, especially towards the thickened, acute apex; ovary sparsely to densely covered with short, white hairs. Pods erect, very narrowly elliptic to linear or narrowly oblanceolate to linear-oblanceolate, basally tapered, \pm straight-sided or sometimes variably indented between some seeds, flat, mostly 2.5–7 (10) cm long, 5–10 mm wide, thinly woody, scurfy, obliquely striate, with slightly thickened margins, opening elastically from apex (each side often curling back). Seeds oblique, oblong- to narrowly oblong-elliptic, 4–6 mm long, light to dark brown; pleurogram with pale halo; areole open, slightly depressed; funicle-aril narrowly conical. (Figure 1)

Selected specimens examined (typical variant). WESTERN AUSTRALIA: 770.3 miles [1235 km] on North West Coastal Highway, A.M. Ashby 4036 (AD, PERTH); Great Sandy Desert, E end of Lake Auld, J.S. Beard 3237 (PERTH); Port Hedland, J.S. Beard 4000 (NSW); Finucane Island, B. Carr B6 (NSW, PERTH); 13 km N of Lyndon River, H. Demarz 7650 (PERTH); Roebourne, Apr. 1901, L. Diels Herb. W.V. Fitzgerald (NSW); 6 miles [9.7 km] N of Roebourne, C.A. Gardner 6342 (PERTH); Telfer Mining Centre, E.M. Goble-Garratt 24 (PERTH); 70 km W from Western Australian border on Tanami Track, D. Keith & B. Pellow 133 (NSW, PERTH, SYD); bottom of Wolf Creek Crater, D. Keith & B. Pellow 154 (NSW, PERTH, SYD); Cape Bossut, K.F. Kenneally 6308 (PERTH); 'Nita', SW of Broome, F. Lullfitz 6222 & 6222a (NSW); near Well 24, Canning Stock Route, B.R. Maslin 2269 (CANB, K, MEL, PERTH); 2.5 km N of Exmouth Gulf homestead, B.R. Maslin 4759 (PERTH); 63.5 km N of Sandfire Roadhouse on Great Northern Highway, B.R. Maslin 4880 (PERTH); 60 km N of Minilya Roadhouse on the North West Coastal Highway, A.A. Mitchell 1316 (NSW, PERTH); The Pilbara, near Wickham, I.V. Newman 708 (NSW); Great Northern Highway, 225 miles [360 km] S of Broome, J. Olsen 511 (NSW); 2 km N of La Grange Mission turnoff, B. Pellow 229 (NSW, PERTH, SYD); Um [near] Roebourne, E. Pritzel 280 (NSW).

Selected specimens examined (small-flowered variant). WESTERN AUSTRALIA: Wolf Creek Crater, A.S. George 15333 (NT, PERTH); Djaluwon Creek, near S end of Lake Gregory, A.S. George 15424 (NT, PERTH).

NORTHERN TERRITORY: 20.2 miles [32.5 km] NW of The Granites, 3 May 1958, G. Chippendale s.n. (NSW, NT); 183 miles [293 km] from Yuendumu towards Rabbit Flat, C.H. Gittins 2286 (NSW);

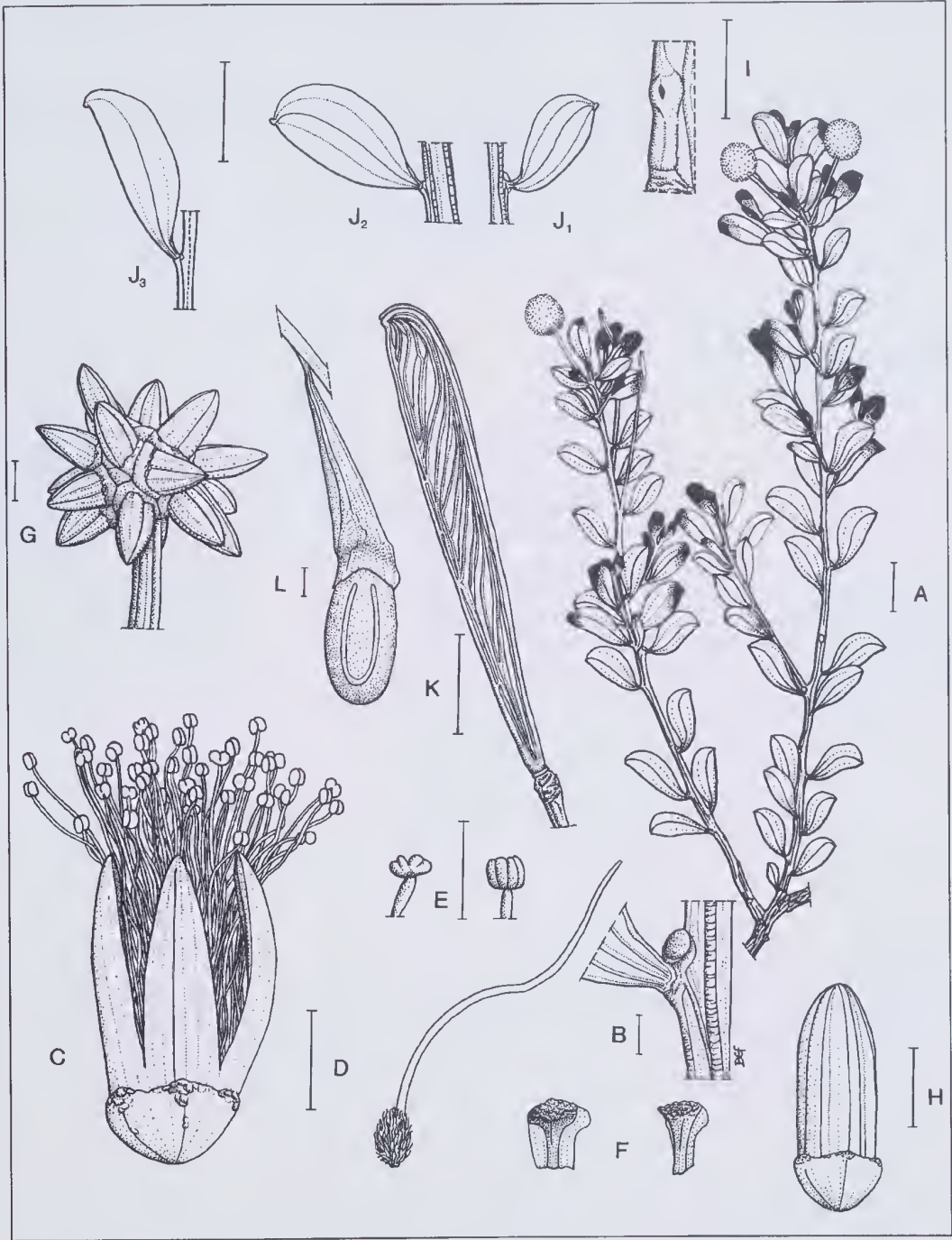


Figure 1. *Acacia stellaticeps*. A - branchlet with inflorescences; B - phyllode base and part of stem; C - flower; D - gynoecium; E - anthers; F - bracteoles; G - capitulum in bud; H - flower bud; I - phyllode basal gland; J₁-J₃ phyllode; K - pod; L - seed. Scale bar for A, J, K = 1 cm, scale bar for B-D, F-I, L = 1 mm, scale bar for E = 0.5 mm. Drawn by Don Fortescue from Newman 708 (A-F, H-J₁), Beard 4000 (G), Olsen 511 (J₂), Ashby 4036 (J₃) and Lullfitz 6222a (K,L).

26 km S of Rabbit Flat turnoff on Tanami Track, D. Keith & B. Pellow 126 (DNA, NSW, PERTH, SYD); 21 miles [33.8 km] NW of Granites, J.R. Maconochie 999 (BRI, DNA, K, MEL, NSW, NT, PERTH).

Distribution. Occurs in Western Australia from the north-west coast between Exmouth Gulf and Broome east across parts of the Great Sandy Desert to the Sturt Creek area and into Northern Territory in the Tanami area; recorded between 18°00'S and 23°30'S.

Habitat. Grows in red, sometimes clayey or stoney sand, over quartzite, limestone, laterite or ironstone, on hills, alluvial flats or sandplains, often on flats between parallel sand dunes as well as on sand ridges, in open savannah, scrub heath, grassland or shrubland, often with spinifex.

Phenology. Flowering recorded from February to September; mature pods collected in August to October and December.

Etymology. The species name refers to the star-shaped capitate heads when in bud.

Variants and affinities. There is a group of specimens collected from arid country in the Sturt Creek area, Western Australia, to The Granites–Rabbit Flat area, Northern Territory, representing a variant of *A. stellaticeps*. It occurs within, as well as east and south of, the eastern distribution range of typical *A. stellaticeps*, and is characterized by smaller, more compact flower heads (5–7.5 mm diam.) often containing a larger number of flowers (up to 35 per head) which are usually also smaller (corolla 1.5–1.9(2.5) mm long; calyx length similar to typical *A. stellaticeps*). Other flower characteristics (e.g. striated petals) and the phyllodes and pods appear to be the same as in the typical variant of *A. stellaticeps*. The small-flowered variant might prove to merit recognition as a subspecies but requires further investigation, for example with regard to the occurrence of both variants in the area of Wolf Creek Crater, Western Australia.

Acacia stellaticeps is related to *A. translucens* in the '*A. stigmatophylla* group', but is distinguished mainly by its prominently spreading, large flower buds, often larger flowers with striated petals, and a ± erect knob-like to conical mucro on the phyllodes (the apical mucro is initially flattened against the lamina margin in *A. translucens*). Also related to *A. nuperrima* Baker f. and *A. setulifera* Benth.

Hybrids. *Acacia stellaticeps* appears to hybridize with *A. arida* Benth. in the Roebourne–Wickham area (K. Glennon 196, PERTH) and *A. hilliana* Maiden near Eighty Mile Beach camping ground (L. Thomson LXT1172A & B, PERTH). *Acacia sphaerostachya* E. Pritz., from the Pilbara region, is probably a hybrid between *A. stellaticeps* and *A. ancistrocarpa* Maiden & Blakely; the two putative parents and *A. sphaerostachya* have been recorded as being sympatric in a few places.

Acknowledgements

Bruce Maslin (PERTH) and Peter Wilson (NSW) provided valuable assistance during the preparation of this paper. Jim Grimes (MEL) kindly supplied information on the publication of *Acacia humilis*. We are grateful to PERTH for the loan of specimens.

Reference

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Notes on *Eucalyptus* series *Orbifoliae* (Myrtaceae) including a new species from central Australia

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Abstract

Nicolle, D. Notes on *Eucalyptus* series *Orbifoliae* (Myrtaceae) including a new species from central Australia. *Nuytsia* 13(3): 487–493 (2001). A key and distribution map for all taxa of *Eucalyptus* ser. *Orbifoliae* Brooker & Hopper are provided. *Eucalyptus minniritchi* Nicolle is described to accommodate populations of mallees in central Australia previously referred to as *E. orbifolia* F. Muell. or *E. websteriana* Maiden and related to both. The new species differs from *E. orbifolia* in the smaller buds with a short hemispherical operculum, the smaller and narrower adult leaves and the generally smaller, hemispherical fruits and differs from *E. websteriana* in the consistently and strongly pruinose adult parts and generally coarser leaves, peduncles, pedicels, buds and fruits. *E. lata* L.A.S. Johnson & K.D. Hill, a species recently described to accommodate what is here recognized to be typical *E. orbifolia*, is synonymised with that earlier named species. The status of *E. educta* L.A.S. Johnson & K.D. Hill and its relationship to *E. orbifolia* is discussed.

Introduction

Populations of mallees from central Australia described here as the new species *Eucalyptus minniritchi* have previously been attributed to *E. orbifolia* (Chippendale 1988; Brooker & Kleinig 1990, 1994) or to *E. websteriana* Maiden (Boomsma 1981). Chippendale (1981) in the treatment of *Eucalyptus* for “Flora of Central Australia” included both *E. orbifolia* and *E. websteriana* as well as “*E. aff. orbifolia*” for populations of mallees that are here recognized to represent a single taxon in central Australia. Hill & Johnson (1992) recognized the distinctiveness of the central Australian populations in comparison with those of the goldfields of Western Australia. However, they erroneously referred the central Australian populations to typical *E. orbifolia*, despite correctly citing the type locality from the original publication as southern Western Australia. The authors simultaneously erected a new species, *E. lata*, to accommodate the Western Australian goldfields populations. Nicolle (1997) in recognizing the nomenclatural error of Hill and Johnson, included the central ranges populations with typical goldfields *E. orbifolia*, but stated that the central ranges population may represent a distinct taxon. Further field collections and research have indicated that the central ranges populations and goldfields populations are sufficiently distinct to warrant taxonomic recognition.

Taxonomic treatment

Eucalyptus series **Orbifoliae** Brooker & Hopper, *Nuytsia* 9(1): 40 (1993). Type: *Eucalyptus orbifolia* F. Muell.

A small series of nine taxa (six species and three subspecies), all except one species endemic to Western Australia. All taxa are restricted to granite outcrops or otherwise rocky areas on skeletal soils, except for *E. ewartiana* Maiden which may also occur in gravelly sands in more or less flat landscapes.

The series is distinguished by its combination of mallee or scraggy tree habit; presence of a lignotuber; distinctive minniritchi-type bark; absence of pith glands; bisected cotyledons; broad juvenile leaves; dull, slightly blue-green to greyish adult leaves; 3–7-flowered inflorescences; ovules in four vertical rows; pale creamy-yellow flowers and level to ascending broad disc on the fruit.

The term 'Minni Ritchi' [minniritchi] was first proposed to describe this distinctive 'crisped' bark type in eucalypts by Brooker & Hopper (1982) but has long been widely used to describe the superficially very similar bark type in some *Acacia* species. The minniritchi bark type in eucalypts is distinctive and characterized by smooth bark that is not fully deciduous but decorticates from the edges of thin longitudinal strips. These strips become curled inwards from the edges and remain attached to the stem. The partially attached curled bark is coppery or reddish-brown in colour exposing younger greenish or yellowish non-curved bark beneath.

Key to taxa of *Eucalyptus* series *Orbifoliae*

1. Leaves on mature plant sessile **E. crucis** subsp. **crucis**
1. Leaves on mature plant petiolate
 2. Adult leaves lanceolate, tapering to a point
 3. Operculum longer than hypanthium; juvenile leaves sessile
 4. Fruits 8–13 mm long, 14–20 mm diam. **E. crucis** subsp. **praecipua**
 4. Fruits 7–8 mm long, 10–14 mm diam. **E. crucis** subsp. **lanceolata**
 3. Operculum equal to or shorter than hypanthium; juvenile leaves petiolate **E. ewartiana**
 2. Adult leaves obovate to orbicular, emarginate or rounded
 5. Operculum conic to beaked, 8–16 mm long
 6. Operculum > 3 times as long as wide **E. educta**
 6. Operculum < 3 times as long as wide **E. orbifolia**
 5. Operculum rounded, 3–6 mm long
 7. Fruits 7–10 mm long; plant prominently pruinose **E. minniritchi**
 7. Fruits 5–7 mm long; plant not or lightly pruinose
 8. Branchlets & buds lightly pruinose **E. websteriana** subsp. **websteriana**
 8. All parts non-pruinose **E. websteriana** subsp. **norsemanica**

1. *Eucalyptus orbifolia* F. Muell., *Fragm.* 5: 50 (1865). Type citation: Ad bases montium graniticorum Novae Hollandiae austro-occidentalis interioris, longitudine 119°25', latitudine 30°47'. C. Harper. Type: 30°47' S, 119°25' E, Western Australia, C. Harper s.n. (holo: MEL; iso: K).

Eucalyptus lata L.A.S. Johnson & K.D. Hill, *Telopea* 4(4): 630 (1992), *syn. nov.* Type: 13.6 km west of Callion on Mussions Soak road, Western Australia, 28 November 1986, K.D. Hill 2658 & L.A.S. Johnson (*holo*: NSW; *iso*: CANB, CBG, MEL, PERTH).

Notes. Distinguished within the series by the combination of pruinose branchlets, buds and fruits; the bluish, orbicular adult leaves (mostly broader than long; 35–55 mm long by 25–60 mm wide); the large buds (10–14 mm long) with a conic to beaked operculum and the large fruits (12–17 mm wide), often flared at the rim and therefore campanulate rather than hemispherical.

Eucalyptus orbifolia, as now recognized, is endemic to the goldfields region of Western Australia being bounded approximately by Youanmi in the north, Mt Gibson in the west, Bullfinch in the south and Menzies in the east (Figure 1). Its distribution is to the west of, and allopatric with, that of its closest relatives *E. minniritchi* and *E. websteriana*, but is completely sympatric with *E. ewartiana* and partially sympatric with *E. crucis* Maiden (subsp. *lanceolata* Brooker & Hopper and *praecipua* Brooker & Hopper). Hybrids of *E. orbifolia* with any other taxon of *E. ser. Orbifoliae* are unknown.

2. *Eucalyptus minniritchi* Nicolle, *sp. nov.*

Frutex 'mallee' effusus ad *Eucalyptum* seriem *Orbifoliae* Brooker & Hopper pertinens, ad 3 m altus, cortice 'minniritchi' omnino. Ramulosi glauci. Folia adulta petiolata, alternantia, obovata vel orbicularia, emarginata, pro parte maxima longiora quam latiora, 18–46 mm x 10–35 mm, hebetia, cinerea, subglauc. Inflorescentiae axillares, simplices, 7-florae. Pedunculi 6–22 mm longi, pedicellis 2.5–8 mm longis. Alabastra glauca, 6–10 mm x 5–8 mm, hypanthium hemisphericum vel cupulatum, operculum hemispherici. Fructus glauci, pedicellati, hemispherici vel complanati-hemispherici, 7–10 mm x 8–16 mm.

Typus: southern slope of Mt Deering, Dean Range, Petermann Ranges, Western Australia, 25°07'12"S, 128°54'28"E, 14 July 1999, D. Nicolle 2692 & J. Connors (*holo*: PERTH; *iso*: AD, CANB, NSW, DNA).

Spreading *mallee*, often of dense habit, 2–3 m tall. Bark of the *minniritchi* type, glossy, red-brown to grey, decorticating in longitudinally split, thin strips that curl back and remain partially attached, revealing smooth reddish, greenish or yellowish brown bark beneath. Forming *lignotubers*. *Branchlets* pruinose, pith glands absent. *Cotyledons* bisected. *Seedling leaves* opposite at first, soon becoming ?alternate, petiolate, ovate at first, later becoming orbicular and emarginate, to 35 mm long, to 30 mm wide, concolorous, dull, bluish. *Adult leaves* sometimes pruinose, especially on new growth, alternate?, with petiole 7–18 mm long, blade elliptic to obovate and emarginate, tip very bluntly apiculate to strongly emarginate, 18–46 mm long, 10–35 mm wide, concolorous, dull, grey or bluish; reticulation dense, oil glands scattered to abundant, moderately large, irregularly-shaped, mostly at intersections of veinlets. *Inflorescences* axillary, unbranched, mostly 7-flowered; peduncles not greatly thickened, flattened and slightly widening towards summit, 6–20 mm long; pedicels terete, 2.5–8 mm long. *Buds* pruinose, globose to ovoid, 6–10 mm long, 5–8 mm diam.; operculum hemispherical (or bluntly conic, especially when immature), 5–6 mm long, apiculate to rounded, +smooth, scar present. *Stamens* very pale yellow, irregularly flexed, all fertile; anthers yellow, dorsifixed, ovoid, opening by lateral pores. *Flowers* pale creamy yellow. *Ovules* in 4 vertical rows. *Fruits* usually pruinose, especially when young, pedicellate, broadly obconic to hemispherical (not including the disc), 7–10 mm long, 8–16 mm diam., smooth; disc slightly ascending to prominently ascending, 2–5 mm wide; operculum scar to 1 mm wide; valves 4 or 5, exserted. *Seeds* angular-ovoid, dull to slightly glossy, grey-brown to almost black, finely reticulate; chaff linear, red-brown.

Selected specimens examined: WESTERN AUSTRALIA: type locality, 14 July 1999, *D. Nicolle* 2687 & *J. Connors* (PERTH, AD, CANB). SOUTH AUSTRALIA: upper Slopes of Mt. Woodroffe, 11 Aug. 1962, *D.E. Symon* 2693 (AD, NSW); upper Alaka Crcek, on summit of hill at c. 4000 ft [1220 m], 19 May 1983, *R. Bates* 3028 (AD); Musgrave Range, slope of Mt Woodroffe 3/4 way up, 17 Apr. 1950, *J.B. Cleland s.n.* (AD, BRI). NORTHERN TERRITORY: near summit of Mt Hermannsburg, MacDonnell Ranges, 24°00'S, 132°39'E, 19 Apr. 1995, *D. Nicolle* 1354 (AD); Mt Sonder, 24 Nov. 1988, *B.G. Thomson* 2713 (AD, DNA, NT); Mannana Range, Petermann Reserve, 24°56'S, 129°17'E, 10 Sep. 1978, *P.K. Latz* 8035 (AD, NT).

Distribution and habitat. Most collections are from the MacDonnell Ranges in the vicinity of Mt Zeil south to the Krichauff Range in the Northern Territory. It also has a more poorly collected occurrence to the south and west, recorded from the Petermann Ranges (Mannana Range in the Northern Territory and the Dean Range on the border between Western Australian and Northern Territory) and the Musgrave Ranges in far north-western South Australia (Figure 1). It occurs on the slopes and ridges of sandstone hills in gravelly or shaley skeletal soils in open mallee shrubland with *Triodia* understorey. Associated eucalypt species include *Corymbia eremaea* (D.J. Carr & S.G.M. Carr) K.D. Hill & L.A.S. Johnson (subsp. *eremaea* and *oligocarpa* (Blakely & Jacobs) K.D. Hill & L.A.S. Johnson), *E. sessilis* (Maiden) Blakely, *E. trivalvis* Blakely, *E. gillenii* Ewart & Kerr and *E. lucens* Brooker & Dunlop.

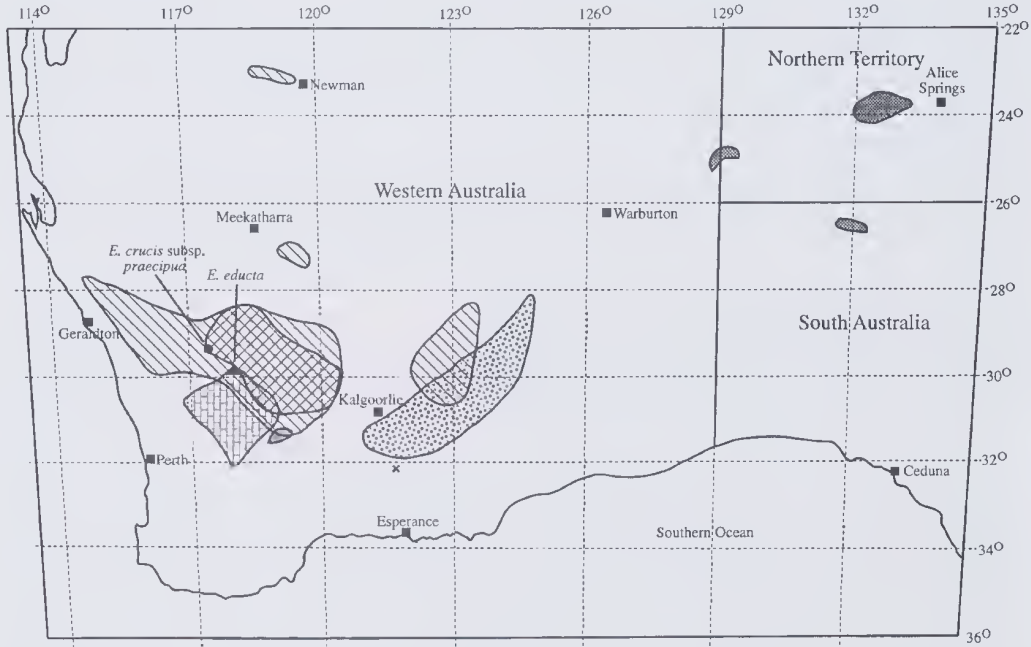











Figure 1. Distribution of *Eucalyptus* series *Orbifoliae*

- | | | |
|---|---|---|
|  <i>E. crucis</i> subsp. <i>crucis</i> |  <i>E. crucis</i> subsp. <i>lanceolata</i> |  <i>E. crucis</i> subsp. <i>praecipua</i> |
|  <i>E. educta</i> |  <i>E. ewartiana</i> |  <i>E. minniritchi</i> |
|  <i>E. orbifolia</i> |  <i>E. websteriana</i> subsp. <i>norsemanica</i> |  <i>E. websteriana</i> subsp. <i>websteriana</i> |

Conservation status. Of scattered occurrence although usually locally common, in remote and inaccessible areas where it is not considered to be under any threat. Known from several conserved areas in the MacDonnell Ranges west of Alice Springs, while most other populations occur on tribally owned lands.

Flowering period. Poorly known. Recorded in flower in June.

Etymology. The specific epithet refers to the bark type of this species, and although common to all taxa of *Eucalyptus* ser. *Orbifoliae* and also present in the monospecific *E. ser. Caesia* Brooker & Hopper, it is the only species with minniritchi bark occurring outside of Western Australia.

Notes. Distinguished within the series by the combination of pruinose branchlets; the petiolate, bluish, obovate to retuse adult leaves (20–50 mm long by 15–32 mm wide) that are usually longer than wide; the pruinose, small buds (6–7 mm long by 5–6.5 mm wide) with a short, hemispherical operculum and the pruinose, medium-sized fruits (relative to other taxa in the series; 8–9 mm long by 9–15 mm wide).

Eucalyptus minniritchi is in many characteristics intermediate in morphology between *E. orbifolia* and *E. websteriana*, although it is morphologically distinct from both (Table 1). In the strongly pruinose adult morphology, *E. minniritchi* is closest to *E. orbifolia*, while the bud morphology is more in common with *E. websteriana* (especially subsp. *websteriana*). In its leaf and fruit morphology *E. minniritchi* is intermediate between the other two species.

Discussion. There is some overlap in quantitative characters such as leaf, bud and fruit size within *Eucalyptus orbifolia*, *E. educta* L.A.S. Johnson & K.D. Hill, *E. minniritchi* and *E. websteriana* (including subsp. *norsemanica* L.A.S. Johnson & K.D. Hill), although these taxa are generally well defined by qualitative characters such as operculum and fruit shape that are relatively consistent throughout each taxon's distribution. Because of the variability and subsequent overlap of size of some characters between one or more of the above mentioned taxa, the five taxa could be equally well placed as five subspecies of *E. orbifolia*. However, specific status is preferred in order to show the equal relationship of *E. minniritchi* to both *E. orbifolia* and *E. websteriana* while at the same time maintaining a more resolved classification by indicating the lower degree of distinctiveness of *E. websteriana* subsp. *websteriana* and *norsemanica* to one another than to other members of the series. Specific status for the central Australian populations, described here as a new species, was also adopted by Hill and Johnson (1992) when they erroneously described *E. lata*.

In order to produce a more informative classification, *Eucalyptus educta* may be best placed as a subspecies of *E. orbifolia*. Typical *E. educta*, is known from a single population of only a few plants, perhaps a single genetic individual, covering a very small area that is geographically at the western edge of the distribution of *E. orbifolia*. Some atypical individuals (and possibly populations) of *E. orbifolia* collected away from the type locality of *E. educta*, but within the distribution of typical *E. orbifolia*, possess characteristics tending towards those seen in *E. educta*, such as a very long operculum (e.g. D. Nicolle 335, near Callion, Western Australia). It is not known if such collections represent morphological variability within *E. orbifolia* and thus morphological overlap of diagnostic characters between *E. orbifolia* and *E. educta* or are intergrades between these two species. Although subspecific status for *E. educta* (within *E. orbifolia*) may well be a more accurate representation of the former taxon's relationship within the series, the combination is not made here, judgement for such requiring further survey and research to establish the true identity and origin of *E. educta*.

Table 1. Differentiating characters between *E. orbifolia*, *E. minniritchi* and *E. websteriana*.

Taxon	<i>E. orbifolia</i>	<i>E. minniritchi</i>	<i>E. websteriana</i>
Distribution	northern to central goldfields of Western Australia	Central Ranges of the Northern Territory, South Australia and Western Australia	eastern and southern goldfields and western Great Victoria Desert of Western Australia
Pruinosity	branchlets, buds and fruits prominently pruinose	branchlets, buds and fruits prominently pruinose	branchlets and buds lightly pruinose in subsp. <i>websteriana</i>
Adult leaf shape	orbicular, mostly broader than long	obovate to retuse, mostly longer than broad	obovate to retuse, always longer than broad
Adult leaf size	35–55 mm long 25–60 mm wide	18–46 mm long 10–35 mm wide	15–40 mm long 12–30 mm wide
Peduncles	thick, 6–22 mm long	6–20 mm long	slender, 8–17 mm long
Pedicle	thick, 1–6 mm long	2.5–8 mm long	slender, 3–8 mm long
Bud size	10–14 mm long 8–9 mm wide	6–8 mm long 5–8 mm wide	5–8 mm long 5–6 mm wide
Operculum shape	conic to beaked	hemispherical	hemispherical
Fruit size	7–10 mm long 12–17 mm wide	7–10 mm long 8–16 mm wide	5–7 mm long 8–12 mm wide
Fruit shape	hemispherical to campanulate	hemispherical	hemispherical

Acknowledgements

I would like to thank the staff of the State Herbarium of South Australia for continuing support and access to the herbarium facilities. Ivan Holliday is thanked for bringing to my attention the confusion surrounding the locality where the type of *Eucalyptus orbifolia* was collected.

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A taxonomic update of *Stenanthemum* (Rhamnaceae: Pomaderreae) in Western Australia

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Abstract

Rye, B.L. A taxonomic update of *Stenanthemum* (Rhamnaceae: Pomaderreae) in Western Australia. *Nuytsia* 13(3): 495–507 (2001). A generic description of *Stenanthemum* Reissek is given, together with a key and distribution maps for the 23 species occurring in Western Australia. *Stenanthemum leucophractum* (Schledl.) Reissek is nominated as the type species of the genus. Three new species from south-western Australia, *Stenanthemum liberum* Rye, *S. patens* Rye and *S. sublineare* Rye, are described and illustrated, and new seed measurements are given for *S. cristatum* Rye. All of the new species have conservation priority.

Introduction

When the genus *Stenanthemum* (Rhamnaceae) was reinstated (Rye 1995), many new Western Australian species were described but no key to species or distribution maps provided. Since then two new species of *Stenanthemum* have been discovered in south-western Australia, and new collections have been made of a species that was illustrated in the earlier paper under the informal name *Stenanthemum* sp. Mt Clifford (*R. Cumming* 1267) but was considered to be too poorly known to describe at that time. These three new species are described here and a generic description of *Stenanthemum* is given to cover all the currently named species. This paper also gives distribution maps and a key for Western Australian taxa.

In the new tribal classification of the Rhamnaceae by Richardson *et al.* (2000), *Stenanthemum* and its close relatives were placed in tribe Pomaderreae Reissek ex Endl. Although the genus *Stenanthemum* was not mentioned in this publication, at least one member of the genus, *S. complicatum* (F. Muell.) Rye, was sampled but was listed under its earlier name of *Spyridium complicatum* F. Muell. This species was clearly separated in the molecular cladogram (Richardson *et al.* 2000: Figure 1) from other genera of the tribe, including *Cryptandra* Sm. (represented by a single species of uncertain identity) and *Spyridium* Fenzl (represented by *S. globulosum* (Labill.) Benth.). An additional species of uncertain identity, referred to as *Spyridium* cf. *forrestianum*, is presumably a second species of *Stenanthemum* as it had a similar molecular makeup to *S. complicatum*, these species together forming a clade. If this

assumption is correct, then Richardson *et al.*'s molecular data give some support for the recognition of *Stenanthemum* as a genus distinct from the two genera in which its species have previously been placed, *Cryptandra* and *Spyridium*.

Taxonomy

Stenanthemum Reissek (Reissek 1858: 295). – *Spyridium* sect. *Stenanthemum* (Reissek) F. Muell. *nom. inval.* (Mueller 1862: 77). – *Cryptandra* sect. *Stenanthemum* (Reissek) Suess. (Suessenguth 1953: 118). *Type: Stenanthemum leucophractum* (Schledl.) Reissek., lectotype here nominated.

Cryptandra subg. *Solenandra* Reissek (Reissek 1848: 288). – *Solenandra* (Reissek) Kuntze *nom. illeg.* (Kuntze 1891: 120), *non* Hook. f. (Bentham & Hooker 1873: 43). – *Cryptandra* sect. *Solenandra* (Reissek) Post & Kuntze (Post & Kuntze 1903: 150). *Type: not designated.*

Shrubs low to tall, usually lacking spinescent branchlets; indumentum present on young stems and at least part of the flowers, of simple and/or stellate hairs, *Stipules* borne on a somewhat to very hairy base (and usually distinctly less hairy than the base), free to the outside of petiole and generally not appearing to meet there, often shortly to largely connate to the inside of petiole, persistent. *Petioles* very short. *Leaf blades* toothed or entire, conduplicate in bud in most species and often not opening flat (i.e. remaining with a distinct fold along the midvein) at maturity, a few species with recurved to revolute margins, the lower surface usually hairy. *Flowers* sessile or subsessile and closely subtended by at least 2 floral bracts, several to many flowers aggregated into dense head-like clusters surrounded by bracts and leaves; bracts imbricate, brown in most species. *Floral tube* adnate to ovary and with a long or short free tube extending above summit of ovary. *Sepals* 5. *Petals* 5, clawed, with a cupped lamina enclosing an anther in bud. *Disc* adnate to the free floral tube or apparently absent, often lining the tube to the level of the stamen insertion but shallowly scooped to deeply indented between the stamens, glabrous. *Ovary* 3-celled. *Style* glabrous or occasionally with a few hairs at base if ovary summit is hairy; stigmatic lobes 3, spreading. *Fruit* a schizocarp, inferior, indented between the rounded summits of the fruitlets, partially to fully enclosed within the floral tube and bracts; fruitlets (monocarps) crustaceous, dehiscing over the summit and down inner surface, with an open basal attachment forming a basal hole when the fruitlet is shed. *Seeds* with a darkened base, moderately to prominently mottled above; aril moderately large, fleshy, clear-translucent to white or pale ferruginous, with one inner (adaxial) and two lateral lobes.

Notes. A genus of at least 28 species, occurring mainly in central and southern Australia, particularly in Western Australia where there are currently 23 species recognized, and also represented by one species in northern Queensland. Distributions of the species in Western Australia are given in Figures 1–3. The Western Australian species are endemic except for *S. notiale*, which also occurs in South Australia and Victoria, and *S. petraeum*, which extends into Northern Territory.

Several other Western Australian species possibly should also be included in the genus *Stenanthemum* but differ in disc and/or fruit characters from the above description. Treatment of these species is being postponed until studies of the generic boundaries in the Rhamnaceae by Kevin Thiele (in prep.) have been finalized.

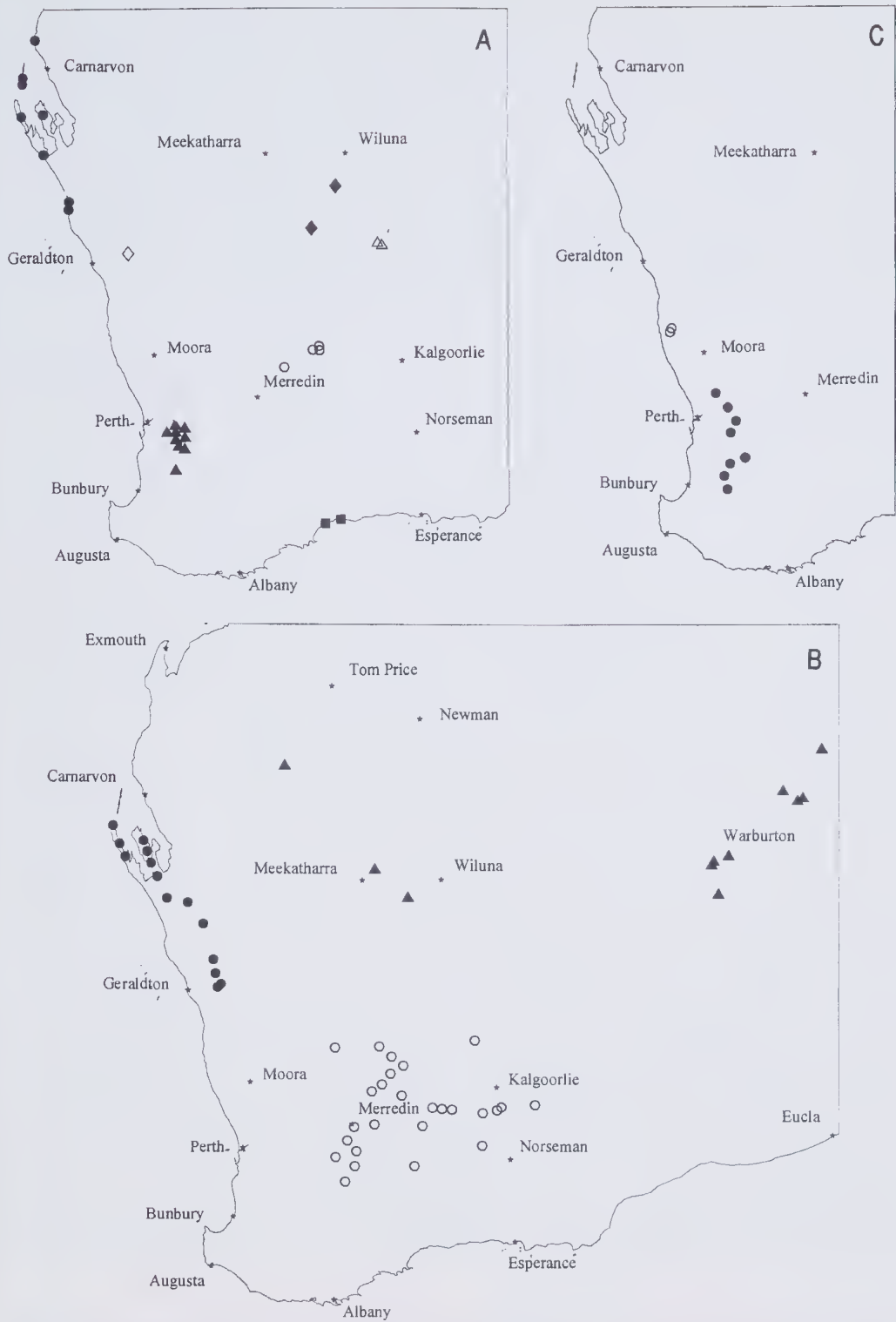


Figure 1. Geographic distributions. A – *Stenanthemum bilobum* Rye ◇, *S. cristatum* ■, *S. divaricatum* Rye ●, *S. nanum* Rye ▲, *S. newbeyi* Rye ○, *S. mediale* Rye ◆ and *S. patens* △; B – *Stenanthemum complicatum* (F. Muell.) Rye ●, *S. petraeum* Rye ▲ and *S. stipulosum* Rye ○; C – *Stenanthemum coronatum* (Reissek) Reissek ● and *S. limitatum* Rye ○.

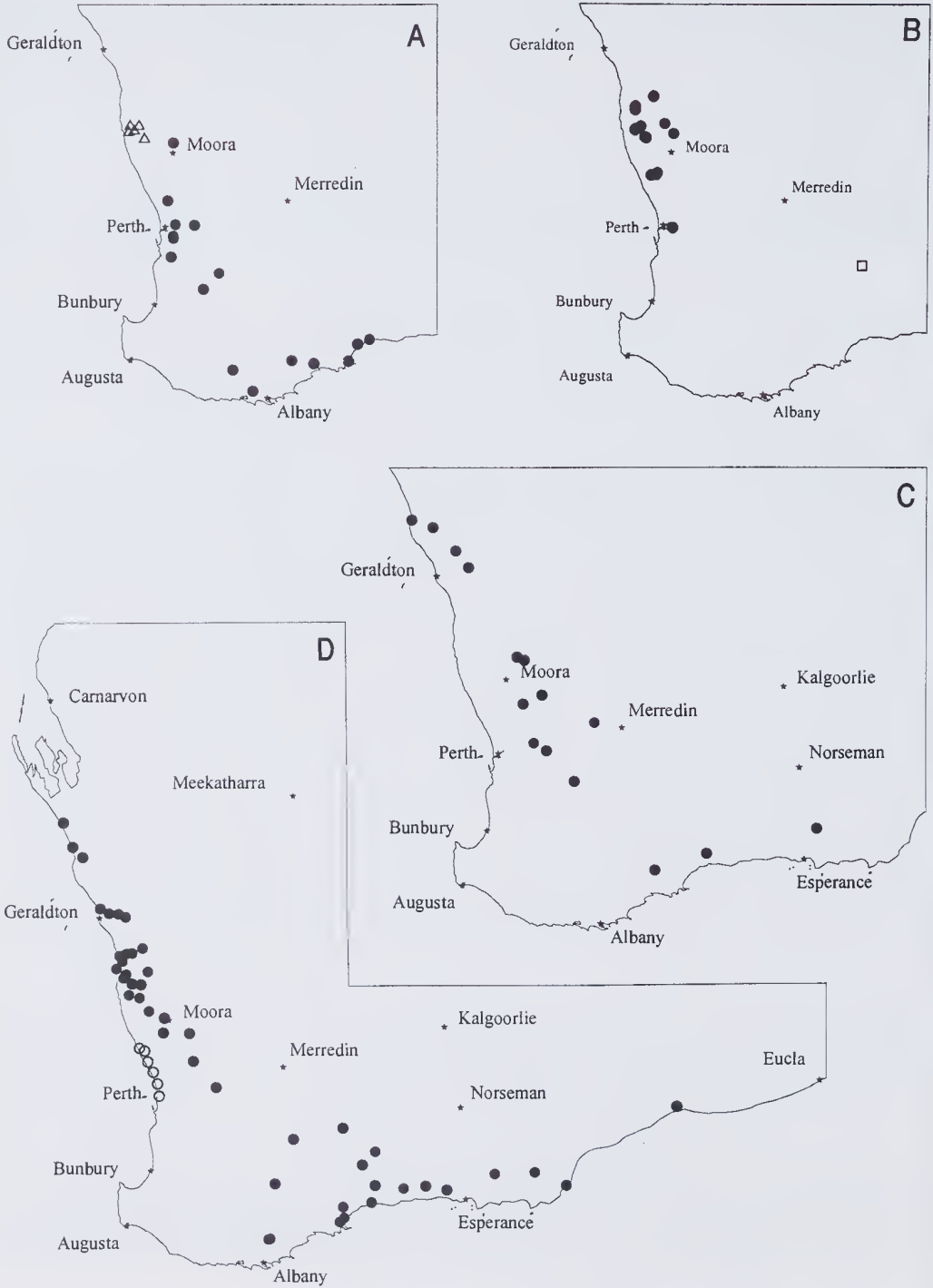


Figure 2. Geographic distributions. A – *Stenanthemum emarginatum* Rye ● and *S. reissekii* Rye △ ; B – *Stenanthemum humile* Benth. ● and *S. liberum* □ ; C – *Stenanthemum intricatum* Rye; D – *Stenanthemum notiale* subsp. *chamelum* Rye ○ and *S. notiale* Rye subsp. *notiale* ● .

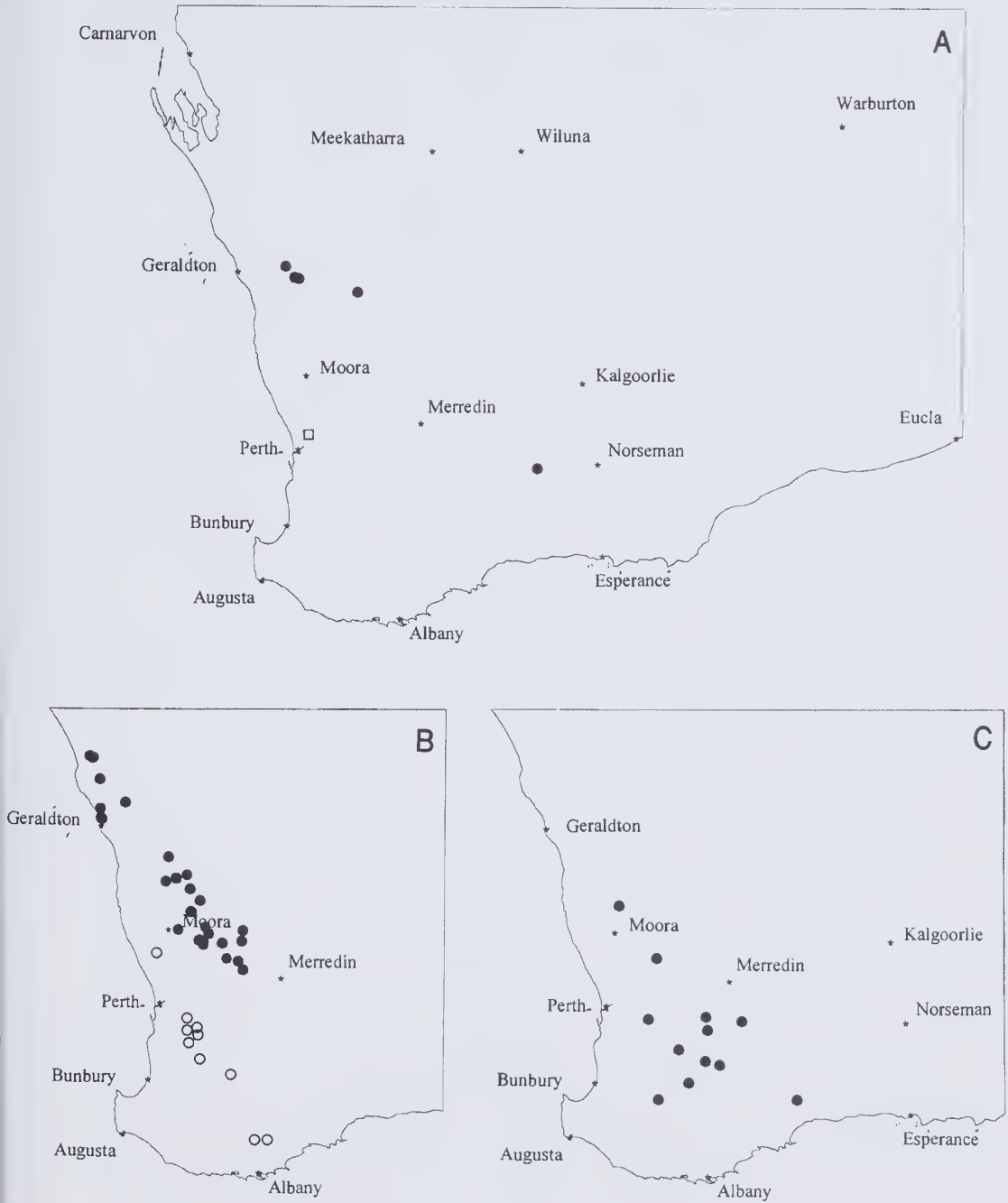


Figure 3. Geographic distributions. A – *Stenanthemum poicilum* Rye ● and *S. sublineare* □; B – *Stenanthemum pomaderroides* (Reissek) Reissek ● and *S. pumilum* (F. Muell.) Diels ○; C – *Stenanthemum tridentatum* (Steud.) Reissek.

Key to species and subspecies of *Stenanthemum* in Western Australia

1. Floral tube (in flower) 0.6–1.3 mm long; free portion 0.3–0.8 mm long, shorter than or about as long as the sepals
2. Stipules free or connate for less than a quarter of their length
3. Leaves with prominently recurved margins
 4. Leaves prominently 2-lobed at apex; upper surface densely hairy. Bracts whitish. Floral tube c. 0.7 mm long, enlarging to c. 1.7 mm long in fruit. (Mullewa area) ***S. bilobum***
 4. Leaves rounded or very slightly lobed at apex; upper surface minutely papillose. Bracts brown. Floral tube c. 1.2 mm long, enlarging to c. 2.8 mm in fruit. (Forrestania area) ***S. liberum***
3. Leaves with margins more or less flat or incurved
 5. Leaves minutely stellate-hairy on upper surface. Ovary summit glabrous. Schizocarp with long deciduous simple hairs, becoming glabrous. (Adelong Station to Kulin to Norseman) ***S. stipulosum***
 5. Leaves with minute patent simple hairs on upper surface. Ovary summit densely hairy. Schizocarp hairy, usually densely so, with both long simple and short stellate hairs, sometimes becoming almost glabrous. (Dirk Hartog Island to Mullewa) ***S. complicatum***
2. Stipules connate for one-third to over half their length
 6. Leaves with margins recurved to revolute and meeting midvein on undersurface. Floral tube with large and small hairs on adnate portion, glabrous on free portion ***S. sublineare***
 6. Leaves with margins flat to recurved but well separated from midvein. Floral tube hairy throughout or with upper part more densely hairy than lower part
 7. Floral tube (in flower) with the longest hairs 0.8–1 mm long. Sepals with hairs extending c. 0.5 mm beyond the apex. (Fitzgerald River National Park.) ***S. cristatum***
 7. Floral tube (in flower) with longest hairs 0.3–0.5 mm long. Sepals with hairs extending 0.1–0.3 mm beyond the apex
 8. Leaves narrowly obtriangular or rarely obtriangular, the apex emarginate between 2 prominent acute lobes, papillose on upper surface; lower surface with long antrorse simple hairs tending to obscure the stellate ones. (Gunyidi to Stirling Range and Fitzgerald River National Park) ***S. emarginatum***
 8. Leaves narrowly to broadly obovate to obcordate, entire or with 1 or more teeth on each side of apex or with 2 prominent obtuse lobes, either hairy on upper surface or with stellate hairs on lower surface not hidden
 9. Floral tube densely hairy in the lower half and usually throughout. Schizocarp with a dense covering of short stellate hairs combined with scattered long antrorse hairs, sometimes becoming almost glabrous when very old

- 10. Leaves with 1–3 or more teeth on each side of apical point; upper surface glabrous, papillose or with minute to short, patent to widely antrorse simple hairs
- 11. Leaves 2–8 mm long, the margins flat or recurved; upper surface with minute to small hairs, sometimes becoming glabrous. Occurring in inland and near-coastal locations, in sandy or clayey soils, sometimes associated with laterite or granite. (Kalbarri to Mt Ridley) **S. intricatum**
- 11. Leaves 5–15 mm long, the margins recurved; upper surface papillose or rarely with minute simple hairs. Occurring in coastal limestone areas. (Lancelin to Perth) **S. notiale** subsp. **chamelum**
- 10. Leaves usually entire, rarely with 1 or 2 teeth on each side of apical point; upper surface usually densely covered by stellate hairs and/or long simple antrorse or appressed hairs, rarely moderately densely hairy. (Kalbarri to Stirling Range and Cocklebidy, also South Australia and Victoria) **S. notiale** subsp. **notiale**
- 9. Floral tube almost glabrous to moderately densely hairy in lower part. Schizocarp rather to very sparsely hairy, either with scattered stellate hairs only or with simple hairs, which are often mixed with a few large stellate hairs
- 12. Branchlets not spinescent. Leaves with 1 or 2 prominent teeth on each side of apex. Lower floral tube sparsely hairy or appearing glabrous. Schizocarp largely glabrous but with scattered stellate hairs. (Gunyidi to West River) **S. tridentatum**
- 12. Branchlets often spinescent. Leaves with 2 apparently obtuse lobes (the apical point recurved). Floral tube moderately densely hairy. Schizocarp with a rather sparse indumentum of long simple hairs and often also a few large stellate hairs. (Quobba Station to Kalbarri) **S. divaricatum**
- 1. Floral tube (in flower) 1.5–6 mm long; free part 0.9–5 mm long, longer than the sepals
- 13. Disc apparently absent
- 14. Flowers with very prominently hairy sepals and a less hairy or partly glabrous floral tube
- 15. Leaves usually almost linear, rarely narrowly obovate, with revolute margins somewhat separated or meeting below. (Eneabba to Perth) **S. humile**
- 15. Leaves narrowly to broadly obovate, obtriangular or obcordate, conduplicate at first, the margins not recurved or, if so, then widely separated below. (Darling Range to Stirling Range) **S. pumilum**
- 14. Flowers with sepals not obviously more hairy than floral tube
- 16. Leaves 2.5–7 x 2.5–6 mm, with 2 or 3 relatively inconspicuous lateral veins on each side of midvein, minutely stellate-hairy on upper surface. (Wilroy to Bremer Range) **S. poicilum**
- 16. Leaves 8–23 x 5–12 mm, with 5–8 prominent lateral veins on each side of midvein, glabrous or papillose on upper surface except for Kalbarri variant. (Kalbarri to Yorkrakine) **S. pomaderroides**

13. Disc lining floral tube, with u- or v-shaped sinuses between the stamen traces
17. Leaves with upper surface minutely stellate-hairy. (North Leonora area) **S. patens**
17. Leaves with upper surface glabrous, papillose or with simple hairs
18. Stipules free or connate for less than one quarter of their length. Disc with shallow u-shaped sinuses between the stamen traces
19. Leaves with minute simple patent hairs on upper surface. Ovary glabrous. (Mt Manning Range to Ennuin Station) **S. newbeyi**
19. Leaves minutely tuberculate on upper surface, sometimes also with a few long appressed hairs. Ovary summit densely hairy. (Mt Augustus to central ranges, also Northern Territory) **S. petraeum**
18. Stipules connate for one quarter to half their length. Disc with fairly deep v-shaped sinuses between the stamen traces
20. Leaves narrowly obovate, entire, obtuse, without a definite apical point. (Badgingarra area) **S. reissekii**
20. Leaves obovate or obtriangular to circular, laterally toothed at the apex or emarginate, with a recurved to erect apical point
21. Leaves with apex and margins entire. Occurring in the Ereman Botanical Province. (Yeelirrie and Black Hill Stations) **S. mediale**
21. Leaves with apex emarginate or with 1 or more small teeth on each side of apex. Occurring in the South West Botanical Province
22. Bracts ovate or broadly ovate. Floral tube 1.5–1.8 mm long in flower, enlarging to 3–3.5 mm in fruit. (Darling Range) **S. nanum**
22. Bracts subulate to narrowly triangular. Floral tube 2.5–3.5 mm long in flower, either not distinctly enlarging (*S. coronatum*) or enlarging to 5–6 mm (*S. limitatum*) in fruit
23. Outer bracts 2.5–3 mm long. Free portion of floral tube densely stellate-hairy (and with long simple hairs) not greatly contrasting with the very densely hairy adnate portion. Ovary summit glabrous. (Clackline to Darkan) **S. coronatum**
23. Outer bracts 1.5–2 mm long. Free portion of floral tube rather sparsely stellate-hairy (and with a few long simple hairs) in marked contrast to the very densely hairy adnate portion. Ovary summit with hairs c. 0.2 mm long. (Mt Lesueur area) **S. limitatum**

Stenanthemum cristatum Rye (Rye 1995: 284).

Notes. At the time this species was described, the seed morphology was omitted. Mature seeds have now been found on *C.A. Gardner & W.E. Blackall* 1406. They are typical of their genus, being prominently mottled with the base darkened and with a 3-lobed basal aril. The seed body is c. 1.3 x 0.7 mm and very pale brown with dark brown stripes and splodges. The aril is ferruginous-translucent and almost 1 mm long.

Stenanthemum liberum Rye, *sp. nov.*

Stipulae librae; folia margine recurvata, supra papillosa; tubus floralis brevis, parte libra sepalis brevior.

Typus: west of South Ironcap [precise locality withheld], Western Australia, 8 September 1996, N. Gibson 2515 (*holo:* PERTH 04695216; *iso:* CANB).

Shrubs dwarf or prostrate, probably c. 0.05 m high, not spinescent. *Young stems* with a dense tangled indumentum; hairs mostly c. 0.3 mm long, fine. *Stipules* free, 2–3 mm long, acuminate, sparsely hairy or glabrous. *Petioles* c. 1 mm long, densely hairy. *Leaf blades* elliptic to obovate, 4–5 x 2.5–3.5 mm, entire, with recurved margins and a short recurved apical point; lower surface with a very dense indumentum of appressed simple hairs; upper surface minutely papillose, green. *Flowers* several to fairly numerous in axillary or terminal clusters 3–8 mm wide. *Floral bracts* several per flower, mostly broadly ovate, up to c. 1.5 mm long, distinctly pointed to long-acuminate at apex; outer surface largely glabrous or glabrous towards upper margins, with simple appressed hairs concentrated along the midvein. *Floral tube* c. 1.2 mm long (enlarging to c. 2.8 mm in fruit); adnate portion of tube c. 0.5 mm long, with curved simple hairs c. 0.5 mm long; free portion of tube c. 0.7 mm long, with a very dense tangled indumentum of simple hairs, which are intermediate in length between those on the adnate base of tube and those on the sepals. *Sepals* c. 0.9 mm long, with a fairly dense tangled indumentum of simple hairs, the largest hairs c. 0.3 mm long. *Disc* not clear on the old flowers examined, possibly absent. *Ovary summit* glabrous. *Style* c. 1.0 mm long. *Schizocarp* c. 2.5 mm long. *Seeds* somewhat compressed, more or less elliptic in outline, c. 1.3 x 0.9 mm, prominently mottled with pale to medium brown and almost black patches; aril with the inner lobe very prominent. (Figure 4A–E)

Other specimen examined. WESTERN AUSTRALIA: near South Ironcap [precise locality withheld], 6 Sep. 1996, N. Gibson 2518 (PERTH).

Distribution. Endemic to the South West Botanical Province of Western Australia. Known only from near South Ironcap, east of Hyden. (Figure 2B)

Habitat. Recorded in yellow sandy loam over laterite, in vegetation dominated by *Eucalyptus argyphaea*.

Phenology. Flowers and fruits: August to September.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority One. Known only from two localities not far apart.

Etymology. From the Latin *liber* – free, not joined, referring to the free stipules.

Notes. Previously known informally as *Stenanthemum* sp. South Ironcap (N. Gibson 2515). The species is possibly related to *Stenanthemum poicilum* Rye, the two species having a similar seed, but *S. poicilum* is readily distinguished by its longer flowers and several leaf characters including the presence of minute stellate hairs on the upper surface.

Only old flowers are present on the two specimens of *S. liberum* examined, so flower measurements need to be checked when flowering material becomes available.

Stenanthemum patens* Rye, *sp. nov.

Stenanthemi stipulosi simile sed ramulis magis divergentibus et aliquantum spinescentibus, floribus et fructis grandioribus differt.

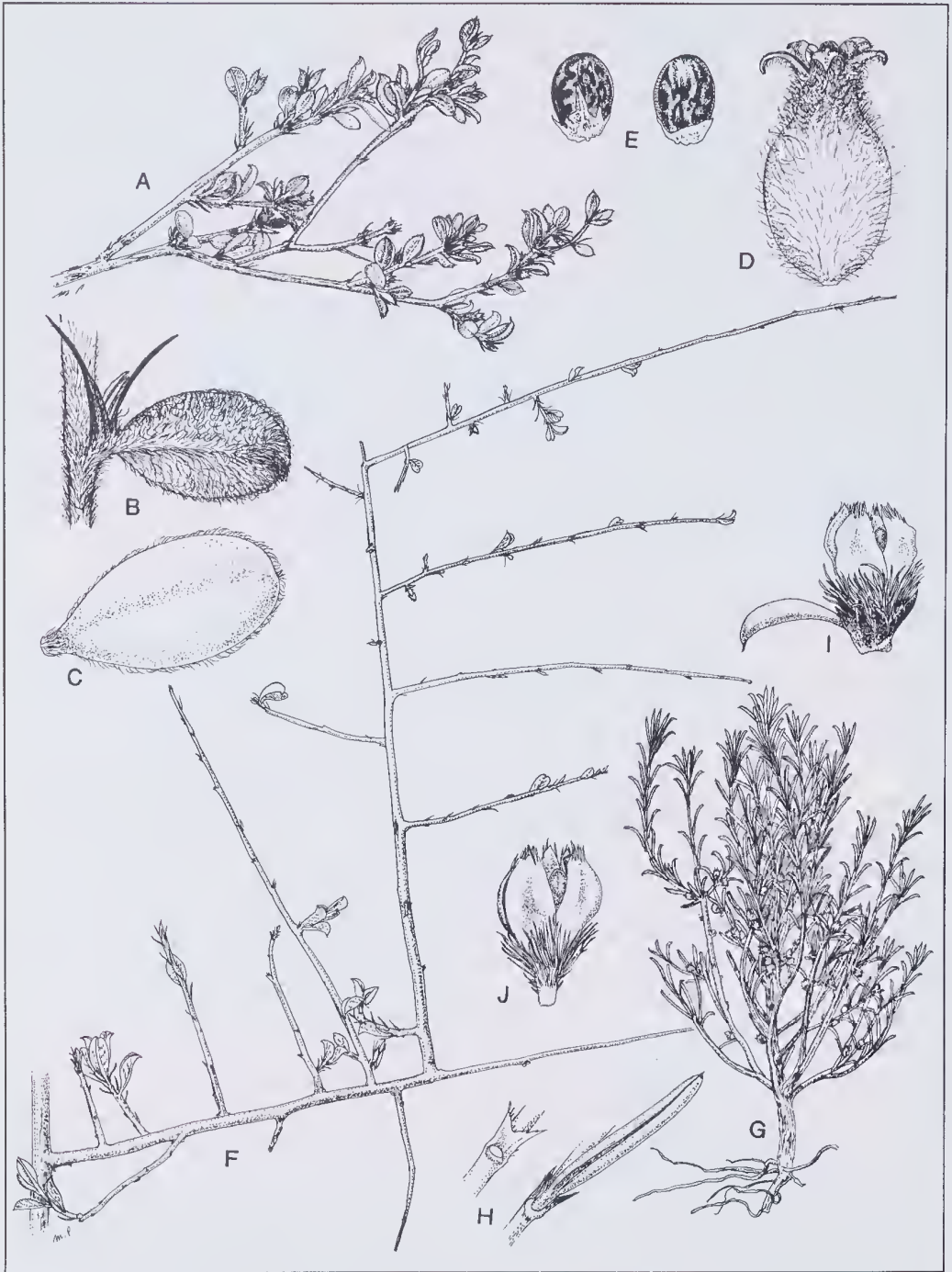


Figure 4. A-E. *Stenanthemum liberum*. A - fruiting branch (x1), B - stipules and leaf undersurface (x7), C - leaf upper surface (x7), D - fruit enclosed in floral tube (x12), E - inner and outer surfaces of seed and aril (x10); F - *Stenanthemum patens*, branching habit (x1); G-J. *Stenanthemum sublineare*. G - whole plant (x1), H - stipules and undersurface of leaf (x6), I - young flower with subtending leaf and bracts (x12), J - flower and pedicel (x14). Drawn from N. Gibson 2518 (A-E), M. Hudson & K. Stratford 2997 (F) and M. Hislop 1023 (G-J).

Typus: between Teutonic and Mt Clifford [precise locality withheld], Western Australia, 16 August 1981, *R. Cumming* 1267 (*holo*: PERTH 02937786; *iso*: CANB).

Illustration. Rye (1995: Figure 11M–P).

Shrub c. 0.5 m high, with widely spreading, apparently somewhat spinescent branchlets commonly 20–100 mm long. *Young stems* with a dense indumentum of simple and much shorter stellate hairs; simple hairs appressed to patent (mostly antrorse), the largest ones c. 0.6 mm long. *Stipules* connate at the base usually for one quarter to almost half their length, 1.3–2.5 mm long, sparsely to moderately densely hairy. *Petioles* 1–2 mm long, densely hairy. *Leaf blades* conduplicate at first, obovate or broadly obovate, 5–8 x 4–5 mm, entire, the margins flat or slightly recurved at maturity, the apex distinctly recurved; lower surface whitish, with 3 or 4 main veins on each side of midvein, with a dense indumentum of simple hairs mostly 0.5–0.8 mm long and short stellate hairs, some of the simple hairs along the veins and margins ferruginous; upper surface grey-green, densely minutely stellate-hairy, sometimes also with a few long simple hairs. *Flowers* fairly numerous in dense clusters 5–8 mm wide; involucre bracts more or less ovate, c. 5 mm long, densely hairy outside except for glabrous margins. *Floral bracts* several per flower, ovate to very broadly ovate, 3–4 mm long, often with two or more apical or subapical points; outer surface with margins glabrous, the remainder densely covered by long deciduous simple hairs; inner surface glabrous. *Floral tube* 2.5–3 mm long (enlarging to 5.5–6 mm long in fruit); free portion 2–2.5 mm long, with a dense indumentum of simple spreading hairs and much smaller stellate hairs; adnate portion c. 0.5 mm long, with a very dense indumentum of simple antrorse hairs c. 1.5 mm long. *Sepals* c. 0.8 mm long, with a dense indumentum of simple spreading hairs mostly c. 0.4 mm long and smaller stellate hairs. *Disc* apparently lining lower half of free portion of floral tube, with deep v-shaped sinuses between the stamen insertion points. *Ovary summit* glabrous. *Style* c. 3 mm long. *Schizocarp* c. 3.5 mm long, with long deciduous hairs on the adnate floral tube. *Seeds* not seen at maturity; aril clear-translucent, prominently 3-lobed. (Figure 4F)

Other specimens examined. WESTERN AUSTRALIA: Bundarra Station [precise locality withheld], 18 June 1997, *M. Hudson* 3049 (PERTH); Bundarra Station [precise locality withheld], 20 July 1997, *M. Hudson & K. Stratford* 2997 (PERTH).

Distribution. Endemic to the Eremean Botanical Province of Western Australia. Known only from Bundarra Station and near Mt Clifford, north of Leonora. (Figure 1A)

Habitat. Recorded from a rocky hillside in low *Acacia* shrubland and from low basalt hills in an open shrubland with *Hemigenia exilis* and *Grevillea inconspicua*.

Phenology. Flowers and fruits recorded in August.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority One. Known only from three localities over a range of less than 20 km. One of the populations on Bundarra Station was recorded as having 50–100 plants.

Etymology. From the Latin *patens* – open, outstretched, used in a botanical sense for diverging from the axis at almost 90 degrees, referring to the tendency for the branchlets to be widely divergent from the axis.

Notes. The informal name *Stenanthemum* sp. Mt Clifford (*R. Cumming* 1267) has been used for this species. It has patent, rather spinescent branchlets, which are stiffly and loosely interwoven to give

the plant a tangled appearance. It is closely related to *Stenanthemum stipulosum* Rye, which differs in its less spinescent habit and shorter flowers and fruits. The two species appear to be allopatric, with *S. patens* occurring north of the range of *S. stipulosum*.

Stenanthemum sublineare* Rye, *sp. nov.

Stipulae connatae; folia fere linearia, marginibus recurvis vel revolutis; pars adnata tubi floralis pilis grandibus, parte libera glabra sepalis brevior.

Typus: west of Bullsbrook [precise locality withheld], Western Australia, 21 December 1997, *M. Hislop* 1023 (*holo*: PERTH 04916972; *iso*: CANB).

Shrubs erect, c. 0.1 m high, c. 0.04 m wide, not spinescent. *Young stems* with few to numerous hairs; hairs simple, antrorse, up to 0.1 mm long, rather coarse and often tooth-like. *Stipules* c. 1 mm long, united for most of their length, acute or acuminate, ciliate. *Petioles* 0.6–1 mm long, glabrous. *Leaf blades* very narrowly ovate-oblong to linear, 4–6 x 0.5–0.8 mm, with recurved to revolute margins, mucronate; lower surface with long appressed simple hairs covering the broad midvein, the remainder of undersurface concealed; upper surface glabrous except for a few tooth-like minute hairs concentrated towards the apex, green. *Inflorescence* of axillary flowers or small axillary clusters up to 4 mm wide, each axil with 1–3 flowers; flowers greenish, with a pedicel c. 0.3 mm long. *Floral bracts* usually 2, ovate or broadly ovate, up to c. 1 mm long, acute or with a broad toothed apex, ciliate; outer surface often hairy towards apex. *Floral tube* c. 1 mm long (not seen in mature fruit); adnate portion of tube c. 0.7 mm long, very densely hairy with a mixture of minute hairs and large simple antrorse hairs, the large hairs c. 0.5 mm long; free portion of tube c. 0.3 mm long, glabrous. *Sepals* c. 1 mm long, largely glabrous but with a few simple antrorse hairs at apex, the largest hairs up to 0.2 mm long. *Disc* glabrous, scarcely lining floral tube, very shallowly scooped between the stamen insertion points. *Ovary summit* glabrous. *Style* c. 0.4 mm long. *Fruit* not seen. (Figure 4G–J)

Other specimen examined. WESTERN AUSTRALIA: W of Bullsbrook [precise locality withheld], 27 Oct. 1997, *M. Hislop* 979 (PERTH).

Distribution. Endemic to the South West Botanical Province of Western Australia. Known only from the Swan Coastal Plain west of Bullsbrook. (Figure 3A)

Habitat. Recorded in littered white sand, in a woodland dominated by *Banksia attenuata* on the coastal plain.

Phenology. Flowers: October to December. Young fruits present in December.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Two. Known only from a single population in a conservation park, where there are at least 50 plants.

Etymology. From the Latin *sub* – somewhat and *linearis* – linear, referring to the almost linear leaves.

Notes. This is one of the few species of *Stenanthemum* to have the leaves almost linear, with recurved margins meeting the midvein of the undersurface. The indumentum on the floral tube is unique in the genus, with large hairs on the adnate portion but no hairs on the free portion. Fruiting specimens are needed for this species to give a more complete description, but it is sufficiently distinctive to recognize from either vegetative characters or floral characters alone.

Acknowledgements

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A taxonomic revision of *Thryptomene* section *Thryptomene* (Myrtaceae)

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Abstract

B.L. Rye & M.E. Trudgen. A taxonomic revision of *Thryptomene* section *Thryptomene* (Myrtaceae). *Nuytsia* 13(3): 509–528 (2001). A revision of *Thryptomene* Endl. sect. *Thryptomene* is presented covering the nine species now included, with distribution maps and a key for all species and illustrations of selected taxa. Five new species and a new subspecies are described. These are *Thryptomene australis* subsp. *brachyandra* Rye & Trudgen, *T. costata* Rye & Trudgen, *T. eremaea* Rye & Trudgen, *T. duplicata* Rye & Trudgen, *T. salina* Rye & Trudgen and *T. striata* Rye & Trudgen. *Thryptomene johnsonii* F. Muell. is reinstated, *T. prolifera* Turcz. is reduced to a synonym of *T. mucronulata* Turcz., and a lectotype is selected for *T. dielsiana* E. Pritz., which is another synonym of *T. mucronulata*.

Introduction

Thryptomene sect. *Thryptomene* (Myrtaceae) is endemic to south-western Australia and is now considered to include nine species, one of which has two subspecies. The section was first defined by Stapf (1924), who included three of the currently recognized species, *T. johnsonii*, *T. mucronulata* and the type species, *T. australis*, as well as two species now reduced to synonymy. Another species included in the section here, *T. decussata*, had been described as a species of *Scholtzia* Schauer and was transferred to *Thryptomene* by Green (1985). Three additional species had been recognized as distinct at the Western Australian Herbarium (PERTH) by the application of informal geographic names and several other new taxa were recognized as new members of the section during this study.

Identification of members of this section has been difficult owing to the small size of the leaves and flowers of these plants, the existence of undescribed taxa, the lack of good keys and descriptions for named taxa, and the misapplication of published names. While the taxonomic revision presented in this paper addresses most of the problems in section *Thryptomene*, there remain many unnamed Western Australian species of *Thryptomene*, most of which belong to section *Astraea* Stapf, but also a few that do not fit readily into either section. Other papers dealing with *Thryptomene* and related genera, including a revision of *Thryptomene* sect. *Astraea*, are presently in preparation.

Methods

Type material was borrowed from MEL and all other specimens examined are housed at PERTH. All measurements were taken from dry pressed material. Leaf measurements were obtained from the larger leaves on each specimen. Flower diameter was taken with petals fully outspread, even though this may be an unnatural measurement in taxa such as *T. mucronulata* in which the petals do not open widely. Since each flower has the sepals that were innermost in bud larger and more fully petaloid than the outer sepals, sepal measurements were taken only from the inner sepals. Fruit shapes and sizes include the encasing hypanthium and disc.

Distribution maps were based on those available from Florabase, the Western Australian Herbarium's database for Western Australian flora, with the Biogeographic Regions shown on them (and referred to elsewhere by codes) being those defined by Thackway & Cresswell (1995). The conservation codes given in this paper are those used by the Western Australian Department of Conservation and Land Management. An explanation of these codes is given at the end of this *Nuytsia* issue.

Distinguishing features of *Thryptomene* sect. *Thryptomene*

Sect. *Thryptomene* is much more closely related to sect. *Astraea* than to the other three sections included in the genus by Stapf (1924). Sect. *Astraea* and sect. *Thryptomene* have a distinctive anther morphology that is restricted to these two sections, while the other sections all have distinct types of anthers (variously differing in the orientation and degree of fusion of the lobes, connective gland and dehiscence characters) and are also distinguished either by inflorescence or hypanthium characters. Although most Western Australian species with the typical *Thryptomene* anther type clearly belong to sect. *Thryptomene* or to the larger sect. *Astraea*, there are several unnamed taxa that do not fall readily into either section, so there may be a need to recognize additional sections in the genus. For simplicity in the discussion below, these few unplaced species are covered by the comments given for sect. *Astraea*.

The typical section is defined primarily by the appearance of the hypanthium, which is prominently longitudinally ribbed but with no other patterning (see Figure 1F,I). The ribs are variable in number and length, with most of them running from the top of the hypanthium to the base while the shorter ones extend part way down from the summit, where there is more space for them. The ribs usually remain closely packed on the fruit. In contrast most members of sect. *Astraea* have a variety of prominent pits, wrinkles or other ornamentations on the hypanthium, sometimes combined with less prominent ribs. The few remaining members of that section either have a smooth hypanthium or more regular ribbing, with 5 ribs opposite the sepals and often a further 5 ribs opposite the petals, and the ribs become widely spaced on the fruit. Members of the other sections recognized by Stapf usually also have 5 or 10 ribs, or a smooth hypanthium.

The other main distinguishing feature of sect. *Thryptomene* is that the species referred to it have 4–8(9) ovules, whereas the members of the other sections have only 2 ovules. A few species of sect. *Astraea* have the two ovules separated in a 2-locular or partially 2-locular ovary, but members of sect. *Thryptomene* and the other three sections always have a unilocular ovary.

Stamen number and arrangement is less definitive but also helps to separate the sections of *Thryptomene* as shown in Table 1. With the fewer species known to Stapf (1924), he was able to simply

Table 1. Comparison of stamen number and arrangement in the sections of *Thryptomene*. Symbols: – absent, + rare, ++ fairly common, +++ common. *Includes a few hexamerous species with 6 sepals and 6 stamens. **When irregularly arranged, some of the stamens are more or less opposite sepals and petals while others are more or less alternating between the sepals and petals.

Stamen number	Stamen arrangement	Sect. <i>Astraea</i>	Sect. <i>Thryptomene</i>	Other three sections
5*	opposite sepals	+	+	+++
10	opposite sepals & petals	+	+++	–
10	alternating with sepals & petals	+++	–	–
variable, (5)6–10(12)	irregular**	++	+++	+
15–30	in 2 whorls	–	++	–

categorize the sections into two groups with 10 stamens (sect. *Astraea* and sect. *Thryptomene*) and 5 stamens (three sections) respectively. This distinction no longer holds so precisely but, with very few exceptions, the two sections of the former group do have larger stamen numbers than the three sections of the latter group.

While there is also no complete separation between sections *Astraea* and *Thryptomene* in stamen number and arrangement, some differences are evident in Table 1. A majority of species in the former section have 10 stamens alternating between the sepals and petals, a situation unknown in sect. *Thryptomene*, in which the regularly 10-staminate species have the stamens opposite the sepals and petals. Unique to the typical section is the occurrence of 15–30 stamens in two whorls, with some exactly opposite the sepals and petals and others at various intermediate positions, sometimes with two stamens (one from each whorl) in the same position (see Figure 1E).

Formal taxonomy

Thryptomene Endl. sect. **Thryptomene**

Shrubs usually medium-sized to tall, glabrous; leaf-bearing stems 4-angled, with whitish bark, usually gland-dotted; older stems losing the white bark in strips to reveal a usually yellowish-brown bark but soon becoming dark grey, rough, commonly fissured, flaky or fibrous. *Leaves* opposite and decussate, rather to very crowded on the branchlets, with a very short petiole; blade concolorous, usually medium green, gland-dotted, entire or denticulate. *Inflorescence* of one to many pairs of axillary units, each unit comprised of a solitary peduncle bearing 1 or rarely 2(3) flowers, each flower sessile within 2 subtending bracteoles, the peduncle very short to far exceeding the subtending leaf. *Bracteoles* imbricate and partially to fully enclosing flower in bud, shorter and more scarious than the

leaves, the thickened midvein usually prominent on abaxial surface, with a subterminal abaxial protrusion or a terminal point. *Hypanthium* united to ovary and to margin of disc, in two species extended with the disc lining for some distance above the ovary, narrowly obconic or obconic at first, becoming more swollen and inverted-campanulate in fruit, longitudinally ribbed, with no other prominent ornamentation; ribs irregular and variable in number, 8–16 extending the full length of the hypanthium and some of these branched to produce some shorter ribs, usually initially acutely angled and separated by more or less v-shaped or broader sinuses but sometimes separated only by fine line-like indentations, usually remaining closely packed in fruit. *Sepals* 5, widely spreading, with a somewhat herbaceous and gland-dotted centre-base and the remainder more petaloid in flower, becoming scarious in fruit, the herbaceous portion usually greenish at first, the petaloid portion white to deep pink, entire or denticulate. *Petals* 5, erectly positioned in a cup-shaped formation in flower or somewhat more spreading, directed inwards and overlapping in fruit, broadly obtuse, white to deep pink. *Stamens* 5–30, commonly 10 opposite the sepals and petals or 7–10 in an irregular arrangement, if 5 then opposite the sepals, if 15–30 then occurring in two whorls both opposite and between the sepals and petals; filament tapering from the base to the apex or sometimes rather slender throughout; anther 2-celled, the cells divergent at base and each dehiscent by a large pore or very short slit, red-brown or red at first and becoming brown; connective gland prominent, at least half as large as each anther cell, often yellowish at first, united to connective at one end, the other end protruding beyond the top of the anther cells, its apex free and directed inwards, releasing contents via an apical pore when pollen is released from anther cells. *Disc* either concave or deep and cup-shaped in flower, the portion attached to the ovary becoming convex in fruit, gland-dotted, often deep pink in late flower. *Ovary* 1-celled, with a near-basal placenta; ovules 4–8(9), all or mostly in 1–4 obliquely superposed pairs (when the ovule number is odd, the uppermost or lowest ovule is unpaired), each pair usually collateral and touching. *Style* central, terminal (not in a depression), with a simple capitate stigma. *Fruit* (including the hypanthium and disc enclosing it) dry, hard, indehiscent, with sepals and petals persistent, when fertile usually 1-seeded, rarely 2-seeded; seed(s) more or less kidney-shaped, soft, with a thin pale yellowish brown coat.

Size and distribution. Nine species are currently recognized. The section is endemic to south-western Australia, with a centre of distribution in the northern part of the South West Botanical Province, but also occurring in the South-western Interzone and the south-western part of the Ereman Botanical Province, with one species extending from there to the southern part of the South West Botanical Province.

Genetic and breeding systems. Two chromosome numbers have been recorded (Rye 1979) for the typical section of *Thryptomene*, the diploid $n = 11$ in *T. mucronulata* [as *T. prolifera*] and the tetraploid $n = 22$ in *T. australis*. All species appear to be protandrous, with pollen also well separated physically from the stigma so that autogamous self-pollination is not possible. Their flowers are attractive to a variety of small insects which could act as vectors for the sticky mixture of pollen and glandular secretion.

The fruit of *Thryptomene* species is normally a nut, with a hard indehiscent casing formed by the disc and hypanthium enclosing a single very soft seed. Since the ovary contains at least two, and in sect. *Thryptomene* at least four ovules, regular production of 1-seeded fruits could only be achieved by a physiological or genetic system, perhaps favouring either the first-fertilised ovule or the genetically fittest zygote to produce the solitary seed. The occasional occurrence of 2-seeded fruits in a number of *Thryptomene* species indicates that those species do not have any fully effective system to prevent more than one seed developing.

Thryptomene australis has an unusually high seed set for the genus. Up to a third of all fertile fruits of this species sampled by Rye & James (1992) were 2-seeded rather than 1-seeded, and there was no evidence of any system to limit seed set to one per fruit. Some kind of incomplete system tending to limit seed set was found, however, in *T. mucronulata* [as *T. prolifera*], because the observed frequency of 2-seeded fruits in that species was significantly lower than the expected frequency based on the number of empty and 1-seeded fruits scored in a large sample.

Key to species and subspecies of *Thryptomene* sect. *Thryptomene*

1. Stamens 15–30, in 2 whorls, arranged both opposite and between the sepals and petals
2. Sepals and petals of about the same length. Style 2.5–3.5 mm long. Ovules 5–7. (Shark Bay to Leonora) ***T. decussata***
2. Sepals distinctly shorter than petals. Style c. 0.7 mm long. Ovules 4. (Binu area) ***T. duplicata***
1. Stamens 5–10(12), in one whorl, variously arranged
3. Stamens 5, opposite the sepals. (East of Hyden) ***T. salina***
3. Stamens 7–10(12), not all opposite the sepals
4. Stamens variable in number and irregularly arranged, with some opposite and some between the sepals and petals
5. Leaves fairly flat, obovate to almost circular, with a recurved mucro or point 0.2–0.5 mm long. Bracteoles persistent in fruit. Ovules 4. (Kalbarri National Park.) ***T. johnsonii***
5. Leaves very thickened at least towards the apex, linear to obovate in outline, with a recurved point 0.5–1.5 mm long. Bracteoles deciduous. Ovules 5–8
6. Leaves triangular or indented-triangular in TS towards the apex and tending to be more flattened below, 3–9 mm long, tapered at apex to a terminal recurved point 0.5–1 mm long. (Dalwallinu to Williams to Cape Arid National Park to Kalgoorlie) ***T. australis***
7. Stamens almost reaching the style when pressed inwards; filament usually 0.8–1 mm long. Style c. 0.8 mm long subsp. ***australis***
7. Stamens well separated from style when pressed inwards; filament usually 0.4–0.6 mm long. Style c. 0.4 mm long subsp. ***brachyandra***
6. Leaves almost terete with an adaxial groove, 2.5–4 mm long, swollen at apex and with a subterminal recurved point 0.8–1.5 mm long. (Menzies to Queen Victoria Springs) ***T. eremaea***
4. Stamens 10, opposite the sepals and petals
8. Leaves with a prominent recurved apical point 1–2 mm long. Style 0.3–0.6 mm long. Ovules 6–9. Occurring on granite outcrops and other rocky sites. (Cue area to Wubin to Menzies) ***T. costata***
8. Leaves with no mucro or a small mucro up to 0.5 mm long. Style 0.6–0.8 mm long. Ovules 4–6. Occurring in low-lying winter-wet habitats or along drainage lines on higher ground

9. Margins of leaves directly below the inflorescences entire or denticulate. Flower buds with hypanthium ribs rounded to almost acute and separated by v-shaped sinuses. (Wilroy to Gingin and Ejanding)..... **T. mucronulata**
9. Margins of leaves directly below the inflorescences with at least a few narrow protrusions up to 0.25 mm long. Flower buds with ribs flattened and closely pressed together giving a striate appearance. (Kalbarri National Park) **T. striata**

Thryptomene australis Endl. (Endlicher 1838: 4). *Type*: “ad orientem ab urbe New-York, Nova Hollandia austro occidentalis”, [east of York, Western Australia], *Roe* (*iso*: K n.v., photograph PERTH 01621408).

Shrubs erect, 0.8–3.5 m high. *Leaves* antrorse or appressed, with apex recurved and apical point widely antrorse to patent w.r.t. stem. *Petioles* 0.7–1 mm long. *Leafblades* linear to narrowly obovate in outline (usually very narrowly obovate) and much thickened near the apex where the TS is either triangular (two outer faces formed by the keeled abaxial surface of the leaf and the other by a flat adaxial surface) or modified from triangular by indentation of the adaxial surface, (3)4–7 x 0.5–1.2 mm not including the prominent apical point, truncate at base, entire, with numerous prominent oil glands on both surfaces, the larger glands c. 0.1 mm diam. or less; apical point recurved, 0.5–0.8 mm long, yellowish or white, sometimes with a pink-tinged base. *Inflorescence* with flowers in 1–11 pairs in a subterminal cluster or spike-like arrangement on each branchlet; peduncles 1-flowered, 1–3 mm long in fruit. *Bracteoles* somewhat scarious, pinkish, narrowly ovate or ovate, usually with an erect to incurved terminal mucro or non-mucronate apex (rarely with a recurved mucro), 1.4–2.4 mm long including point, folded/keeled, caducous or deciduous. *Flowers* 6–7 mm diam.; disc concave. *Sepals* depressed ovate to very broadly elliptic, 1.3–1.5 mm long, 1.6–2.0 mm wide, white or pale pink, entire. *Petals* broadly or very broadly ovate, 2.0–2.4 mm long, white, entire. *Stamens* 7–10(12), irregularly arranged, some opposite and others between the sepals and petals; filament 0.4–1 mm long. *Ovules* 5–7. *Style* 0.4–0.8 mm long. *Fruit* 2–2.6 mm long, c. 2.5 mm diam., 1- or 2-seeded, with 9–11 full-sized and several shorter longitudinal ribs; seed(s) c. 1.4 mm long. (Figure 1A)

Distribution and habitat. South West Botanical Province: AW, ESP, JF, MAL; also South-western Interzone: COO. Extends from near Kalannie (east of Dalwallinu) south to Tarwonga (near Williams), south-east to Cape Arid National Park and inland to near Kalgoorlie. Occurs mainly on granite outcrops and other granitic sites, but also recorded on basalt, in shrublands with a variety of species (e.g. *Acacia lasiocalyx* and *Melaleuca elliptica*) that are normally associated with granite.

Phenology. Flowers mainly July to November. Fruits recorded October to December.

Conservation status. Both subspecies are widespread and common.

Notes. Very closely related to *Thryptomene eremaea* as discussed under that species. *T. australis* appears to set two seeds per fruit more commonly than do other members of the section. Like related species with high and variable ovule numbers, *T. australis* has its ovules mostly in superposed pairs but the uppermost or lowest level often consists of an unpaired ovule. Sometimes the lowest pair consists of two ovules somewhat superposed rather than collateral to fit the narrowed shape of the base of the ovary.



Figure 1. A – *Thryptomene australis* leaf (x5); B–F. *Thryptomene duplicata*. B – flowering branch (x1), C – upper surface of leaf (x5), D – peduncle and bracteoles (x5), E – top view of several stamens with associated petals and sepal, showing 2 stamens from different whorls (one long and one short) arising together opposite a sepal (x10), F – side view of immature fruit (x5); G–J. *Thryptomene eremaea*. G – flowering branch (x1), H – side view of leaf (x5), I – peduncle, bracteoles and flower (x5), J – stamen before (top view) and after (lower three views) dehiscence (x25). Drawn from M. Bennett 35 (A), M.E. & M.R. Trudgen 12012 (B–F) and D.J. Pearson 2212 (G–J).

Thryptomene australis is a widespread species showing considerable geographic variation, with its two main variants treated here as subspecies, the typical one in the western part of the species range with long stamens and the eastern one with short stamens. Specimens from certain areas such as the Fitzgerald region tend to have short leaves.

a. *Thryptomene australis* Endl. subsp. *australis*

Stamens 8–12 (usually 9 or 10), almost reaching the style when pressed inwards; filament usually 0.8–1 mm long. *Style* c. 0.8 mm long.

Selected specimens examined. WESTERN AUSTRALIA: West Arthur shire, behind Tarwonga Hall, 14 July 1992, V. Crowley 4; Wattengutten Hill, c. 27 km ESE of Wongan Hills, 23 Oct. 1992, A.M. Lyne 833, L. Craven & F. Zich (ex CBG); Wilgyne Hill, N of Campion, 9 Sep. 1942, C.A. Gardner 6456; near Young River, c. 21 km NNW of the coast at Stokes Inlet, 20 Oct. 1968, A.E. Orchard 1679 (ex AD); cultivated in Kings Park, ex Bremer Bay road, near Cape Riche turnoff, 26 May 1973, B.L. Powell 73090; King Rocks, E of Hyden, 7 July 1974, B.L. Powell 74028; Boyagin Rock, 28 July 1976, M.E. Trudgen 16911; Dunn Rock Nature Reserve, 25 Sep. 1995, S. Walsh 13.

Distribution. Occurs in all of the Biogeographic Regions listed for the species although almost absent from the Interzone (COO). It occupies the western part of the species range, extending from near Kalannie south to near Williams and eastwards to Frank Hann National Park and Young River. (Figure 2A)

Chromosome number. $n = 22$, $c. 22$ (Rye 1979). Voucher specimens: B.L. Powell 73090, 74028.

b. *Thryptomene australis* subsp. *brachyandra* Rye & Trudgen, subsp. nov.

A subsp. *australi* staminis et stylo brevior differt.

Typus: 98.1 km east of Norseman on Eyre Highway, Western Australia, 16 August 1995, R.J. Cranfield 10063 (*holo:* PERTH 04390962; *iso:* CANB, MEL).

Stamens 7–10 per flower, distinctly separated from the style when pressed inwards; filament usually 0.4–0.6 mm long. *Style* c. 0.4 mm long.

Selected specimens examined. WESTERN AUSTRALIA: 2 km ESE of Mt Newman, 23 Nov. 1990, W.R. Archer 23119112 (ex MEL); Newman Rock, 52 km W of Balladonia, 31 Aug. 1985, B.J. Conn 1878 (ex NSW); Cave Hill, 38 km WSW of Widgiemooltha, 10 Nov. 1994, D.J. Edinger 930; NE base of Peak Charles, 3 Oct. 1986, J.M. Fox 86/282 (ex CANB); granite outcrop c. 10 km ESE of Howick Hill, 19 Sep. 1968, E.N.S. Jackson 1240 (ex AD); Red Hill, 3 km E of Kambalda West, 9 Aug. 1981, K.R. Newbey 8458; 20 km W of Kumarl, 9 Oct. 1966, P.G. Wilson 5659.

Distribution. South West Botanical Province: ESP, MAL; also South-western Interzone: COO. Extends from the Kalgoorlie area via Peak Charles south to the Esperance area and south-east to Cape Arid National Park. (Figure 2A)

Etymology. From the Greek *brachy* – short and *andros* – man, male, referring to short stamen length.

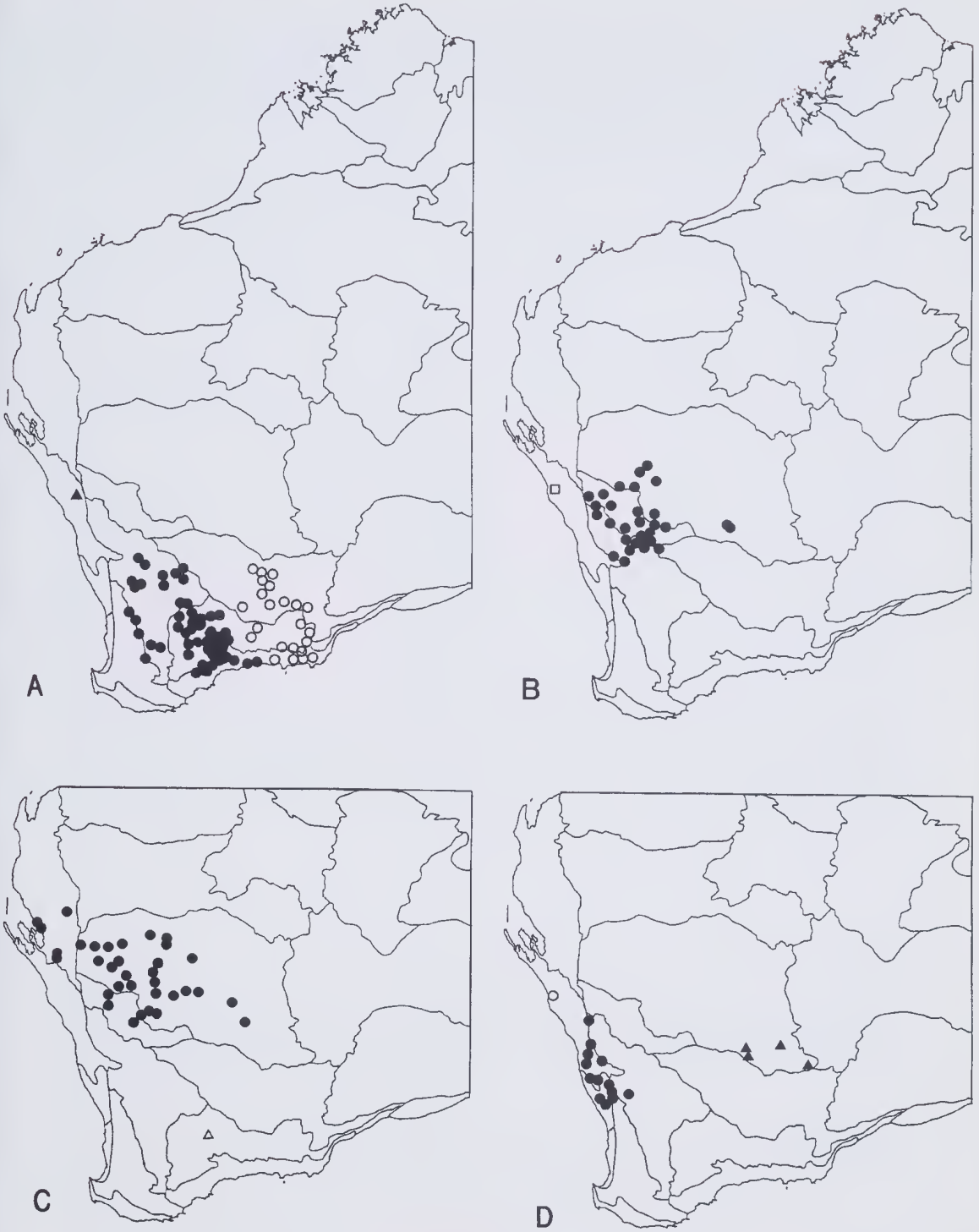


Figure 2. Distributions maps. A – *Thryptomene australis* subsp. *australis* ●, *T. australis* subsp. *brachyandra* ○ and *T. duplicata* ▲; B – *Thryptomene costata* ● and *T. johnsonii* □; C – *Thryptomene decussata* ● and *T. salina* △; D – *Thryptomene eremaea* ▲, *T. mucronulata* ● and *T. striata* ○.

Notes. As well as having shorter stamens and style than subsp. *australis*, the new subspecies tends to have fewer stamens, although both subspecies quite commonly have 9 or 10 stamens. The known geographic distributions of the two subspecies show no overlap, with subsp. *australis* occurring in the west and subsp. *brachyandra* in the east.

Thryptomene costata* Rye & Trudgen, *sp. nov.

Thryptomene mucronulata affinis sed acumine apicali foliorum longiore, bracteolis deciduis et floribus grandioribus differt.

Typus: 300 m north-west of Eastern Tallering Peak, Western Australia, 14 September 1978, M.E. Trudgen 2226 (*holo:* PERTH 02193574; *iso:* CANB, K, MEL).

Shrub erect, (0.5)1–3 m high, single-stemmed at extreme base but usually with numerous branches arising just above the base. *Leaves* antrorse, with apex recurved and usually more or less patent w.r.t. the stem. *Petioles* 0.4–0.7 mm long. *Leaf blades* obovate or broadly obovate, 2–4.3 x 1.4–1.8 mm not including the prominent apical point, truncate or concave at base, entire, dotted with numerous or fairly numerous oil glands, the larger glands c. 0.1 mm diam. or less, fairly flat, the lower surface more or less concave, the upper surface flattened along the keel in lower half of for most of length but with the upper part of keel forming a fold-line/ridge; apical point recurved, 1–1.8 mm long, yellowish at first, sometimes with the base red-tinged, becoming white. *Inflorescence* of up to 6 pairs but usually of 1–4 pairs of flowers at adjacent nodes, rarely of a single flower; peduncles usually 1-flowered, sometimes 2(3)-flowered, 1–2 mm long, if multi-flowered then with 1 or 2 additional stalks arising at summit and somewhat shorter than the peduncle. *Flowers* 7.5–9.5 mm diam.; disc concave. *Bracteoles* early-deciduous (before older bud stage), with a green herbaceous keel and clear scarious sides or sometimes pinkish, narrowly to broadly obovate, 1.3–3 mm long, with a short terminal point, entire, the margins incurved/folded. *Sepals* depressed obovate, 2–2.5 x 2.8–3.5 mm, white or pale pink, entire. *Petals* almost circular or depressed obovate, 2.5–3.3 mm long, white to deep pink, usually pale pink, entire. *Stamens* 10, opposite the sepals and petals; filament 0.5–0.7 mm long, pink (where recorded). *Ovules* 6–8(9). *Style* 0.3–0.6 mm long. *Fruit* 2.3–3 mm long, 3–4 mm diam., with 10–14 full-length and several shorter longitudinal ribs; seed(s) c. 1.4 mm long.

Selected specimens examined. WESTERN AUSTRALIA: 7.7 km E of Coorow on Waddi Rd, 15 Oct. 1982, J. Coleby-Williams 216; 5.6 km W of Yalgoo turnoff from Paynes Find, 17 Sep. 1977, R.J. Chinnock 4024 (ex AD); 24.5 km SSE of Sunday Bore, Perrinvale Station, 7 Sep. 1988, R.J. Cranfield 7129; 43 km N of Mount Magnet, 16 Oct. 1981, L.A. Craven 7131 (ex CANB); Wubin, 6 September 1959, Mrs S. Dela-Hunty; N of Cue, 1 Sep. 1977, J.W. Green 6647; White Wells Station, near third cattle grid on road to homestead from Great Northern Highway, 14 Sep. 1995, T.R. Lally 761; 18 km N of Paynes Find, 24 Sep. 1991, P.G. Wilson 1235 & R. Rowe (ex NSW).

Distribution and habitat. Eremaean Botanical Province: COO, MUR, YAL; also South West Botanical Province: AW, possibly also GS. Extends from north of Cue south to Wubin and from Tallering Peak east to Riverina Station (near Menzies). Occurs on granite outcrops and other rocky sites. (Figure 2B)

Phenology. Flowers May to November, especially August to September. Fruits mainly August to November. Some of the young fruits had 2 equal-sized immature seeds present suggesting that 2-seeded mature fruits are occasionally produced.

Conservation status. A relatively common species with a fairly wide distribution.

Etymology. From the Latin *costa* – rib, referring to the prominently ribbed hypanthium.

Notes. The name *Thryptomene mucronulata* has been widely misapplied to this taxon. Although closely related to *T. mucronulata*, *T. costata* is readily distinguished by the longer apical point on its leaves and its deciduous bracteoles. It also tends to have longer peduncles, larger flowers, a shorter style and more numerous ovules. The two taxa occupy distinct habitats and geographic areas, with their known ranges being almost parapatric. (Figure 2B,D)

Most flowers have 10 stamens opposite the sepals and petals but occasional flowers with abnormal numbers of stamens have been observed such as an 11-staminate flower on *R.J. Cranfield* 6043.

Thryptomene decussata (W. Fitzg.) J.W. Green (Green 1985: 6). – *Scholtzia decussata* W. Fitzg. (Fitzgerald 1904: 19–20). *Type:* Mount Magnet, Western Australia, September 1903, W.V. Fitzgerald (*holo:* PERTH 01631918).

Shrub erect, usually 1–3 m high, often with large galls on the flowers or branchlets; galls globular to pear-shaped with a broad beak, 3–6 mm diam. *Leaves* crowded on the branchlets, mostly widely antrorse. *Petioles* 0.1–0.3 mm long. *Leafblades* broadly obovate to depressed ovate-cordate or rarely obovate, 1.3–2.3 mm long, 1.3–2.7 mm wide, truncate or shallowly concave at base, not mucronate, entire, with a moderately prominent keel and fairly numerous oil glands prominent on both surfaces, the largest glands c. 0.1 mm diam. or less, with the keel incurved and not pointed at the apex, the lower surface concave and the upper surface convex. *Inflorescence* with flowers in 1–3 pairs in a subterminal almost globular cluster on each branchlet; peduncles 1-flowered, c. 0.2 mm long. *Bracteoles* with a narrow keel bordered on each side by a green gland-dotted herbaceous portion and broad scarious incurved margins, depressed obovate, 2–3.3 mm long, with the keel usually terminating level with the scarious margins or exceeded by them, rarely produced at apex into a point 0.2–0.3 mm long, sometimes pink-tinged, persistent after fruit shed. *Flowers* 7.5–9.5 mm diam.; disc deeply cupped. *Sepals* depressed ovate, 2.2–3.3 mm long, 3.3–4.4 mm wide, pink-tinged, tending to become reddish then fading, minutely denticulate or denticulate. *Petals* broadly or depressed obovate, 2.5–3.5 mm long, pink, often deep pink, tending to become reddish or rusty-coloured with age, minutely denticulate or denticulate. *Stamens* in 2 whorls, c. 20 to c. 30, the largest ones with a filament 2.3–3.3 mm long. *Ovules* 5–7. *Style* 2.5–3.5 mm long. *Fruit* 2.3–2.7 mm long, 2.5–3 mm diam., 1-seeded (where known), with 12–16 full-length and 2–6 shorter longitudinal ribs; seed c. 1.4 mm long.

Selected specimens examined (broad-leaved variant). WESTERN AUSTRALIA: 3 miles [5 km] S of Meekatharra, 26 Oct. 1965, J.V. Blockley 128; creek crossing on track to Callytharra Spring, Callytharra Station, 25°49'S, 115°23'E, 31 Aug. 1995, G.J. Keighery & N. Gibson 974; 496 mile peg on North West Coastal Highway [Carbla Station, c. 45 km S of Wooramel Roadhouse], 29 Oct. 1963, L. Lullfütz 2831; 38 km W of Sandstone, 11 Oct. 1977, C.I. Stacey 597; 77.5 km N of Paynes Find on Great Northern Highway, 2 July 1976, M.E. Trudgen 1676.

Selected specimens examined (typical variant). WESTERN AUSTRALIA: Bronzewing-McClure mining site, Melita Station, 30 Nov. 1999, J. Prosser; 2 km W of Cue, 1 Sep. 1977, J.W. Green 4649; 30 km E of Hillview Station, 26 Sep. 1982, A.A. Mitchell 1049; 41 km SW of Leonora, 22 Aug. 1977, A.Z. Parker 175; half way up SE side of hill, Mount Magnet, 2 July 1976, M.E. Trudgen 1680; 2 km from Leonora to Wiluna road intersection on the road to Leinster, 10 Apr. 1992, F.A. Zich 117 (ex CANB).

Distribution and habitat. Eremaean Botanical Province: CAR, MUR, YAL. Quite widely distributed, extending from near Shark Bay inland to Melita Station, near Leonora. Commonly occurs on lateritic breakaways and other high rocky sites, but in the north-western part of the species range also recorded on lower sandy sites, often in Bowgada (*Acacia ramulosa*) shrublands. (Figure 2C)

Phenology. Flowers and fruits mainly July to November.

Conservation status. Known from many populations over a wide area.

Notes. Although this species has been confused with *Thryptomene johnsonii*, it is more closely related to *T. duplicata*; for more details see the notes under those two species. *T. decussata* has shorter peduncles and longer stamens and styles than all other members of sect. *Thryptomene* and tends to have more prominently herbaceous bases to the sepals with the oil glands more obvious and the veins prominent and often rib-like. It also tends to have the hypanthium ribs more widely separated on the fruit than is usual for the section.

A few specimens have labels recording the flower colour as white, but these all have only a few very old faded flowers or fruits attached.

The typical variant of *T. decussata* has mostly broadly obovate to more or less circular leaves 1.3–2.3 x 1.3–1.8 mm and occurs in the eastern inland region from Mount Magnet to Leonora. A variant with mostly depressed ovate-cordate leaves 1.3–2 x 1.5–2.7 mm, occurring in the north-western and central part of the species range and extending east to Anketell (Sandstone area), overlaps with the range of the typical variant. A few very broad leaves are also present on specimens of the typical variant and a few leaves longer than broad are often present on specimens of the broad-leaved variant. There appears to be no clear distinction between the two variants, which apparently intergrade in and west of the Sandstone area. Possibly the typical variant tends to have smaller flowers with shorter stamens than the more common broad-leaved variant, but material of the typical variant is poor with no properly pressed flowers and its flowers are often galled, so comparison is difficult.

***Thryptomene duplicata* Rye & Trudgen, sp. nov.**

Thryptomene decussata affinis sed pedunculis longioribus, floribus parvioribus et ovulis paucioribus differt.

Typus: Binu area [precise locality withheld], Western Australia, 12 December 1993, M.E. Trudgen 12012 & M.R. Trudgen (*holo:* PERTH 04278283; *iso:* CANB, K, MEL).

Shrub c. 0.8 m high, spreading to c. 2 m wide. *Leaves* antrorse to patent, overlapping, the distal half often slightly recurved, the apex slightly incurved to slightly recurved. *Petioles* up to 1 mm long. *Leaf blades* broadly or very broadly obovate, c. 2.6 x 2.5–3.5 mm, indented at base, without a mucro or with a small erect one, entire or minutely serrulate, prominently gland-dotted on both surfaces, with usually 8–12 or more main glands c. 0.1 mm diam. and less obvious glands, the lower surface concave and the upper surface convex. *Inflorescence* with flowers in 2 or 3 pairs in a small subterminal cluster on each branchlet; peduncles 1-flowered, 0.7–1.4 mm long in fruit. *Bracteoles* with a thick herbaceous gland-dotted keel and broad petaloid margins, more or less obovate, c. 2 mm long, the apex recurved and petaloid margins incurved, minutely denticulate on the margins, persistent in fruit. *Flowers* c. 6 mm diam.; disc cupped. *Sepals* depressed obovate, c. 1.4 mm long, 2.5–4 mm wide, minutely denticulate. *Petals* broadly obovate to almost circular with a very short basal claw, c. 2 mm long,

minutely denticulate. *Stamens* apparently c. 15 or more in two whorls, often two stamens arising together opposite each sepal, one with a long filament terminating the stamen rim and the other with a short filament arising lower from inside of stamen rim, others located between the sepals and petals or opposite petals, the largest ones with a filament c. 0.8 mm long. *Ovules* 4. *Style* c. 0.7 mm long. *Fruit* c. 2 mm long, c. 2.5 mm diam., with c. 16 full-length and usually several shorter longitudinal ribs; seed not seen at maturity. (Figure 1B–F)

Distribution and habitat. South West Botanical Province: GS. Known from a single population near Binnu, north of Northampton. Recorded in pale yellow sand in a tall open shrubland dominated by *Actinostrobos*. (Figure 2A)

Phenology. Fruits: November to December.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority One. This species is known from only one collection.

Etymology. From the Latin *duplicatus* – doubled, referring to the large number of stamens in two whorls, roughly double the number found in most members of the genus.

Notes. Previously known by the phrase name *Thryptomene* sp. Binnu East Road (M.E. Trudgen 12012 & M.R. Trudgen).

This species and *Thryptomene decussata* are the only members of the section to have a deeply cupped disc and numerous stamens in two whorls. *T. decussata* has larger flowers than *T. duplicata*, with the sepals almost as long as the petals, longer stamens and styles, and more numerous ovules. It also differs in having almost sessile flowers and fruits. The four ovules of *T. duplicata* are broader (more rounded) than those of species, such as *T. australis*, that have a narrower hypanthium.

***Thryptomene eremaea* Rye & Trudgen, sp. nov.**

Thryptomene australis arcte affinis sed foliis brevioribus tumidioribus apicē late obtuso et acumine longiore subterminali (nec terminali) differt.

Typus: 39.5 km west of Queen Victoria Spring, Queen Victoria Spring Nature Reserve, Western Australia, 27 July 1992, D.J. Pearson 2212 (*holo:* PERTH 0321796; *iso:* CANB).

Shrubs erect, 0.5–1.5 m high. *Leaves* antrorse to appressed, with a recurved apical point. *Petioles* up to 0.6 mm long. *Leaf blades* more or less obovoid or narrowly obovoid but with a longitudinal indentation on adaxial surface, 2.5–4 x 0.6–0.9 mm, rounded-truncate at base, broadly obtuse at apex and with a prominent subterminal point, entire, prominently gland-dotted on both surfaces, sometimes with the glands each at the centre of a prominent recession, the larger glands usually c. 0.1 mm diam.; subterminal point recurved, 0.8–1.5 mm long, whitish. *Inflorescence* with flowers in 1–5 pairs in a small subterminal, often spike-like cluster on each branchlet; peduncles 1-flowered, 1–2 mm long in fruit. *Bracteoles* not enclosing flower bud, somewhat scarious, pinkish, more or less elliptic to ovate, with a long recurved terminal point, 2–2.5 mm long including point, folded/keeled, minutely denticulate on the margins, deciduous. *Flowers* c. 7 mm diam.; disc concave. *Sepals* very broadly or depressed ovate, 1.5–2 mm long, 2–2.5 mm wide, white or pale pink, minutely denticulate. *Petals* broadly or very broadly ovate, 2.7–3.5 mm long, white or pale pink, minutely denticulate or entire.

Stamens 10(11), irregularly arranged, some opposite and others between the sepals and petals; filament c. 0.6 mm long. *Ovules* c. 7. *Style* c. 0.6 mm long. *Fruit* not seen at maturity, with c. 12 full-length and c. 3 shorter longitudinal ribs. (Figure 1G–J)

Other specimens examined. WESTERN AUSTRALIA: 6 miles [10 km] N of Menzies, 16 Sep. 1927, 7 June 1985, C.A. Gardner 2154; near Menzies, Sep. 1927, C.A. Gardner & W.E. Blackall; Comet Vale district, Dec. 1916, J.T. Jutson 214 (ex NSW); Edjudina Station, 7 July 1989, H. Pringle 2362.

Distribution and habitat. Eremean Botanical Province: MUR. Extends from Menzies east to Queen Victoria Spring Nature Reserve. Recorded in yellow sandy soils at Edjudina Station and Queen Victoria Springs Nature Reserve, the former record from shallow soil over granite, the latter in sandplain dominated by shrubland mallee with *Eucalyptus youngiana* and *Triodia scariosa*. Also recorded in red sand near Menzies. (Figure 2D)

Phenology. Flowers July to December.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Two.

Etymology. This species has a more inland distribution than other members of its section and its epithet *eremaea* reflects its occurrence in the Eremaean Botanical Province.

Notes. Previously known by the phrase name *Thryptomene* sp. Queen Victoria Springs (D.J. Pearson 2212).

This species is closely related to *Thryptomene australis*, and both species have a particularly prominent gland on the anther (see Figure 1J). The leaves of *Thryptomene australis* are more angular and less thickened than those of *T. eremaea*, and are tapered at the apex into a terminal point, whereas the leaves of *T. eremaea* end abruptly in a longer subterminal point (Figure 1A, H). The bracteoles of *T. australis* tend to be broader, with a shorter more incurved apical point, and shed earlier than those of *T. eremaea*. *Thryptomene australis* apparently also has narrower sepals and shorter petals, and it tends to have more entire margins to the sepals and petals. The two species appear to be allopatric, with *T. eremaea* occurring further inland than *T. australis* and apparently mainly on sandplain, whereas *T. australis* occurs predominantly on granite outcrops.

Thryptomene johnsonii F. Muell. (Mueller 1864: 77). *Type*: "In Australia occidentali, forsitan ad flumen Murchison" [perhaps at the Murchison River], Western Australia, ?F. Mueller (*holo*: MEL 70701).

Shrub erect, c. 2 m high, sometimes with large galls on the branchlets; galls c. 4.5 mm diam. *Leaves* antrorse or widely antrorse, overlapping and often crowded on the branchlets, with a recurved apical point. *Petioles* 0.4–0.5 mm long. *Leaf blades* mostly obovate to very broadly obovate, 1.7–3.4 x 1.3–1.5 mm not including the apical point, truncate or indented at base, entire, with usually 4–8 very prominent glands c. 0.15 mm diam. in an irregular row or more scattered and also smaller glands on the lower surface, more uniformly and usually less prominently gland-dotted above, the lower surface concave; apical point recurved, 0.2–0.5 mm long, whitish. *Inflorescence* with flowers in 1–4 pairs in a small subterminal almost globular cluster on each branchlet; peduncles 1-flowered, 0.4–0.7 mm long. *Bracteoles* largely scarious, with a narrow keel bordered on each side by a narrow gland-dotted herbaceous portion and broad incurved margins, more or less broadly or very broadly obovate,

1.5–2 mm long, keeled, with a subterminal recurved point 0.1–0.3 mm long, denticulate on the margins, persistent after fruit shed. *Flowers* 6–7 mm diam.; disc concave. *Sepals* very broadly ovate to depressed elliptic, 1.3–1.4 mm long, 2–2.4 mm wide, probably pink, entire or very slightly denticulate. *Petals* broadly obovate to almost circular, c. 2.5 mm long, pink, the centre-base gland-dotted, entire. *Stamens* 8(9), irregularly arranged with some opposite sepals and others between the sepals and petals; filament c. 0.7 mm long, pink. *Ovules* 4. *Style* c. 0.8 mm long. *Fruit* 1.3–1.5 mm long, 1.8–2 mm diam., with commonly 12–14 full-length and several shorter longitudinal ribs, 1- or 2-seeded; seed(s) not seen at maturity but reportedly '2/3 line' [c. 1.3 mm] long (Mueller 1864).

Otherspecimenexamined. WESTERN AUSTRALIA: Kalbarri National Park [precise locality withheld], 3 Oct. 1992, D.R. & B. Bellairs 1149A.

Distribution and habitat. South West Botanical Province: GS. Known only from Kalbarri National Park, recorded on grey sand with sandstone on a sandplain slope, with *Acacia saligna*. (Figure 2B)

Phenology. Flowers and fruits recorded in early October.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Two. This species is known only from the type collection made over 130 years ago and a single recent collection in a national park. In the notes provided for the latter collection, the species was reported to be abundant.

Notes. The identity of this species has long been in doubt. Its name was widely misapplied to *T. decussata* before Green (1985: 6) incorrectly relegated it to synonymy under *T. mucronulata*, a name that was itself misapplied to *T. costata*. Finally in 1992, a second collection of true *T. johnsonii* was made, providing the first indications of the habitat and other aspects of the species' biology.

Thryptomene johnsonii is reinstated here. It is a quite distinct species, differing from both *T. decussata* and *T. costata* in the length of the apical point and number of oil glands on the leaves, stamen number and ovule number, as well as having a quite distinct distribution. It is more similar to *T. mucronulata* but differs in habitat, leaf morphology (especially the smaller number of oil glands) and its lower stamen number.

The type material of *Thryptomene johnsonii* has a few mature fruits, but no flowers, so a complete description of this species was not possible originally. The largest branch examined on the type material was c. 0.3 m long and, judging from the leaf orientation, appeared to have been fairly erect. Bentham (1867) recorded 2 ovules for the species but this appears to be incorrect as ovule number is difficult to determine from fruiting material and the recent collection has 4 ovules. Whereas Mueller (1864) described the species as 1-seeded, Bentham recorded 1 or 2 seeds.

Thryptomene mucronulata [as *mucromulata*] Turcz. (Turczaninov 1847: 156–157). *Type*: "Nova Hollandia" [south-west of Western Australia], 1844, J. Drummond [coll. 3] n. 33 (*holo*: KW n.v.; *iso*: PERTH (ex K) 01621955).

Thryptomene davisiae Diels (*in* Ostenfeld 1921: 95). *Type*: Moora, Western Australia, 25 September 1915, G. Davies Ostenfeld No. 1429 (*n.v.*).

Thryptomene dielsiana E. Pritz. (Diels & Pritzel 1904: 412). *Type*: near Mingenew, Western Australia, 12 September 1901, L. Diels 4255 (*lecto*: PERTH (ex B) 01621432, here designated; *isolecto*: PERTH (ex B) 01621424 in part).

Thryptomene prolifera Turcz. (Turczaninov 1862: 324–325). *Type*: “Ad fl. cygnorum Novae Hollandiae” [between Moore and Murchison Rivers, Western Australia], 1850–1851, *J. Drummond* “coll. 7” [coll. 6] n. 62 (*holo*: KW n.v., photograph PERTH).

Shrub usually erect but occasionally rather low-growing, (0.3)0.5–2(4) m high, up to 2 m wide. *Leaves* antrorse, overlapping. *Petioles* 0.5–0.8 mm long. *Leaf blades* mostly narrowly obovate or obovate, sometimes also a few broadly obovate, (2)2.8–7 x 0.9–1.8 mm, truncate or concave at base, with a mucro 0.1–0.5 mm long or lacking a mucro, entire or denticulate, prominently gland-dotted on both surfaces, the larger glands c. 0.1 mm diam. or less, the lower surface concave or flat and the upper surface often partially flat. *Inflorescence* with flowers in 1–9 pairs in a small subterminal globular to spike-like cluster on each branchlet; peduncles 1-flowered (possibly sometimes 2-flowered), 0.7–1 mm long in fruit. *Bracteoles* with a gland-dotted keel and broad scarious margins, ovate to obovate or broadly so, 1.8–2.5 mm long, keeled, terminating in an small erect point, the scarious margins incurved, denticulate on the margins, persistent after fruit shed. *Flowers* 4.5–6 mm diam.; disc concave. *Sepals* depressed obovate, 1.2–1.7 mm long, 1.8–2.5 mm wide, paler pink than the petals, minutely denticulate. *Petals* broadly obovate to almost circular, 1.5–2.5 mm long, pale pink to deep purplish pink, entire. *Stamens* 10, opposite the sepals and petals; filament 0.5–0.7 mm long, pink. *Ovules* 4–6. *Style* 0.6–0.8 mm long. *Fruit* 1.5–2 mm long, c. 2 mm diam., with 10–12 main and several somewhat shorter longitudinal ribs, 1- or rarely 2-seeded; seed(s) c. 1.3 mm long.

Selected specimens examined. WESTERNAUSTRALIA: Mogumber, Sep. 1903, *C. Andrews*; 13 miles [21 km] N of Gingin, 15 Sep. 1976, *J.S. Beard* 7803; Hill River crossing on Brand Highway, 10 Dec. 1992, *R.J. Cranfield & P. Spencer* 8456, 8457; 3 km along Morowa water supply road from Arrino West Rd, 2 Oct. 1981, *L.A. Craven & C. Chapman* 6841 (ex CANB); 10 km SW of Winchester, 3 Oct. 1981, *L.A. Craven & C. Chapman* 6898 (ex CANB); 20 km NE of Eneabba, 18 Dec. 1986, *H. Demarz* 11615; E of Green Head, SE of Green Lake, at “Lakeland” entrance and branching point of Grover Rd, 30 Sep. 1991, *W. Greuter* 22400; 7 km S of Eneabba, 2 Aug. 1977, *E.A. Griffin* 950; Wotto Nature Reserve, NE of Eneabba, 5 Oct. 1992, *E.A. Griffin* 6865; 1 km S of Wilroy Siding, 6 June 1977, *B.G. Muir*; cultivated in Kings Park, 26 Aug. 1973, *B.L. Powell* 73099; S side of Cantabilling Rd, c. 22 km E of Munbinea Rd, 17 Oct. 1999, *M. Puckridge* 110; Ejanding, Oct./Nov. 1959, *S.B. Rosier* 196; Moore River National Park, 2 Oct. 1971, *R.D. Royce* 9499; 29.3 km S of Moora on road to Mogumber, 19 May 1976, *M.E. Trudgen* 1658; Wongan Hills area, 3.2 km N of Mortlock Creek crossing, 25 May 1976, *M.E. Trudgen* 1664; Hill River, 1 Nov. 1965, *P.G. Wilson* 3789.

Distribution and habitat. South West Botanical Province: AW, GS, SWA. Extends from Wilroy south to near Gingin and Ejanding (north-west of Wyalkatchem). A single specimen annotated with the locality “Murchison” (*E.W. Hursthouse* Oct. 1902, ex NSW) is too vague to map but may have been collected further north than any other specimens included here. Occurs in low-lying winter-wet sites associated with swamps and watercourses, also recorded from higher ground along drainage lines, often with a mixture of clay and sand, sometimes in sand over laterite. (Figure 2D)

Phenology. Flowers: June to November. Fruits: September to December.

Chromosome number. n = 11 (Rye 1979). Voucher specimen: *B.L. Powell* 73099.

Conservation status. Not considered to be at risk as a whole although some variants of the species may be rare.

Typification. Of the available specimens from the two syntypes of *T. dielsiana*, the one chosen here as the lectotype is the one with the more precise locality on the label. The excluded former syntype is: between Moore and Murchison Rivers, Western Australia, *E. Pritzel* 640 (PERTH (ex B) 01621424 in part, 02194848).

Notes. Very closely related to *Thryptomene striata*, which possibly should be regarded as a subspecies but appears to show sufficient differences (see note under *T. striata*) to be treated as a distinct species. *T. mucronulata* includes a number of variants differing in the number of flowers and the morphology of their subtending leaves on each branchlet as well as the morphology of the other leaves, bracteoles and possibly also the hypanthium. Further collecting is needed as there are currently too few specimens of each of the variants to determine their status.

A variant with very narrow leaves and bracteoles, apparently including the type of *T. prolifera*, is restricted to the western part of the species range, recorded from east of Green Head south-east to Hill River (e.g. *R.J. Cranfield* & *P. Spencer* 8456, 8457). Most specimens, including those from the western part of the range, from Eneabba to Moore River, have broader leaves and inland specimens all have relatively broad leaves and bracts, some very broad.

The type specimen of *T. mucronulata* has leaves at the broad extreme of the leaf shape variation in the species. It probably came from the southern part of the species range, possibly in the region "north or east of Bolgart", one of the areas where Drummond obtained his third collection of specimens (Erickson 1969), as other areas listed for this collection are well outside the known range of the species. The type matches material collected from near Gingin and Mogumber fairly well.

The type of *Thryptomene daviesiae* has not been examined but was collected from Moora and possibly matches other specimens collected from that general area, such as *M.E. Trudgen* 1658. The type of *T. dielsiana* has the largest leaves of any specimens in the *mucronulata* complex and does not clearly match any of the variants but perhaps shows most similarity to two specimens from Eneabba (*H. Demarz* 11615, *E.A. Griffin* 950).

Thryptomene salina* Rye & Trudgen, *sp. nov.

Thryptomene mucronulata affinis sed costis supra hypanthium paucioribus et staminibus quinque differt.

Typus: near Emu Rock [precise locality withheld], east of Hyden, Western Australia, 9 October 1981, *K.R. Newbey* 9171 (*holo:* PERTH 02159481; *iso:* CANB, MEL).

Shrub up to 1.1 m high and 1.5 m wide. *Leaves* antrorse, overlapping. *Petioles* c. 0.5 mm long. *Leaf blades* broadly or very broadly obovate or narrowly obovate, c. 2.3 x 2.3–2.6 mm, truncate or shallowly concave at base, often mucronate, the keel usually incurved at apex, with prominent fairly numerous glands mostly less than 0.1 mm diam. on both surfaces, the lower surface concave and the upper surface concave; mucro (when present) subterminal, short and broad. *Inflorescence* with flowers commonly in 3–5 pairs in a small subterminal cluster on each branchlet; peduncles 1-flowered, c. 0.8 mm long. *Bracteoles* scarious, with a narrow keel and broad gland-dotted incurved margins, very broadly ovate, c. 1.5 mm long, pink-tinged, entire or denticulate on the margins, degree of persistence unknown but still present in late bud. *Flowers* not seen at maturity, white in early bud and becoming pale pink in late bud; hypanthium with c. 8 full-length ribs and c. 6 shorter ribs; disc concave. *Sepals* depressed

ovate, c. 1.5 mm long, pinkish at least towards base, entire. *Petals* not seen at maturity. *Stamens* 5, opposite the sepals; filament c. 0.4 mm long. *Ovules* 5. *Fruit* not seen.

Distribution and habitat. South West Botanical Province: MAL. Recorded from near Emu Rock, east of Hyden, in *Melaleuca hamulosa* scrub in deep alluvial sand on a flat along a saline creek. (Figure 2C)

Phenology. Apparently flowers in October.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority One. This species is known only from a single collection.

Etymology. From the Latin *salinus* – salty, referring to the plant's apparent environmental preference.

Notes. A very poorly known species, with its single collection in early to late bud. In its habitat preference it appears to be closest to *T. mucronulata* and *T. striata*, which also favour low-lying sites. These two species can be readily distinguished from *T. salina* by their more numerous ribs on the hypanthium and their ten stamens. *T. salina* differs from all other members of the section in having only five stamens.

***Thryptomene striata* Rye & Trudgen, sp. nov.**

Thryptomene mucronulata arcte affinis sed foliis flores subtentis plus manifeste denticulatis, bracteolis plus manifeste carinatis, et costis hypanthii juvenis planioribus arcte contiguus differt.

Typus: Junga Dam, Kalbarri National Park, Western Australia, 22 September 1994, A.G. Gunness 2383A (*holo:* PERTH 04256468).

Shrubs erect, rounded, 0.5–1 m high and 1–1.5 m diam. *Leaves* antrorse, overlapping. *Petioles* c. 0.6 mm long. *Leaf blades* narrowly to broadly obovate, 2.5–3.8 x 1–2.3 mm, truncate at base, with the keel incurved at apex, not mucronate or with an erect mucro up to 0.1 mm long, prominently gland-dotted on both surfaces, the larger glands usually c. 0.1 mm diam., the lower surface concave and upper surface keeled, the leaves directly below the inflorescences always broad and with at least a few narrow protrusions up to 0.25 mm long mainly near centre and towards base of each margin. *Inflorescence* with flowers in 2–7 pairs in a small subterminal globular to spike-like cluster on each branchlet; peduncles c. 0.7 mm long in fruit. *Bracteoles* with a thick herbaceous gland-dotted keel and very broad scarious margins, more or less obovate or broadly obovate, c. 2 mm long, keeled, terminating in an small erect point, the scarious margins incurved, denticulate on the margins, persistent after fruit shed. *Flowers* 5–6.5 mm diam; disc concave. *Sepals* depressed obovate, 1.4–1.6 mm long, 2.0–2.4 mm wide, with the centre-base gland-dotted and slightly to distinctly herbaceous, the remainder scarious and deep purplish around the herbaceous portion, minutely denticulate. *Petals* broadly obovate to almost circular, 2–2.8 mm long, pink or mauve-pink, entire. *Stamens* 10, more or less opposite the sepals and petals; filament c. 0.7 mm long, pink. *Ovules* 4. *Style* deep pink, c. 0.7 mm long. *Fruit* 1.3–1.6 mm long, c. 2.4 mm diam., with c. 12 full-length ribs and c. 4 shorter ones, more or less flat and closely pressed, the narrow indentations between them resembling lines; seed(s) not seen at maturity.

Other specimens examined. WESTERN AUSTRALIA: Junga gravel pit on Kalbarri road, 23 Sep. 1989, Bellairs 1652; Junga Dam, Kalbarri National Park, 21 Sep. 1990, B.J. Conn 3198 & J.A. Scott (ex NSW); Junga Dam, Kalbarri National Park, 22 Sep. 1994, A.G. Gunness 2383B.

Distribution and habitat. South West Botanical Province: GS. Occurs in Kalbarri National Park in a broad low depression in a sandplain of red sandy soil with ironstone on the surface. According to one record, *T. striata* is the dominant plant at the site. The associated vegetation consists of in a low shrubland including *Melaleuca* and *Malleostemon* species and a herbfield. (Figure 2D)

Phenology. Flowers and fruits recorded in September.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Two. This species is known from four collections from a small area, probably all from a single population, in a national park.

Etymology. From the Latin *striatus* – furrowed, striped, referring to the fine grooves resembling lines between the flattened ribs of the floral tube.

Notes. The phrase name *Thryptomene* sp. Junga Dam (R.J. Cranfield 4833) has been applied to this species. *Thryptomene striata* is very closely related to *T. mucronulata* but differs in having narrow projections on the margins of some of the young leaves (especially those directly below the inflorescence), the apex to the leaf keel more incurved, a more herbaceous keel on the bracteoles, and the hypanthium ribs more flattened and closely pressed together even on the flower buds, which therefore appear striate. It may also tend to have longer petals.

Thryptomene mucronulata occurs in a variety of relatively damp habitats including swamps, and *T. striata* appears also to show a preference for damp habitats as the only known locality is in a broad low depression. *T. striata* occurs further north than *T. mucronulata*, the distance between their known ranges being over 150 km.

Acknowledgements

We would like to thank Paul Wilson for translating the diagnoses into Latin, staff at MEL for the loan of type material, and Margaret Pieroni for preparing the illustration. Distribution maps were based on the Florabase maps prepared by Paul Gioia.

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New taxa in *Goodenia* (Goodeniaceae) from the Kimberley region of Western Australia

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Abstract

Sage, L.W. New taxa in *Goodenia* (Goodeniaceae) from the Kimberley region of Western Australia. *Nuytsia* 13 (3): 529–536 (2001). Three new *Goodenia* species, *G. crenata* Carolin & Sage, *G. inundata* Sage & Pigott and *G. psammophila* Sage & M.D. Barrett, are described and illustrated. The subspecies of *G. psammophila* subsp. *hiddinsiana* Sage & M.D. Barrett is also described. *G. crenata*, *G. inundata* and both *G. psammophila* subspecies are recommended for listing as priority flora for conservation.

Introduction

Wheeler (1992) described and illustrated three unnamed species of *Goodenia* in her treatment of the family Goodeniaceae for “Flora of the Kimberley Region”. Each of these taxa occurs in the Northern Botanical Province (Kimberley) and one extends into the far north of the Eremaean Botanical Province of Western Australia. Further studies and investigations by the author and the species co-authors have revealed that all three taxa require species level recognition, and that one, *G. psammophila*, should be recognized as consisting of two subspecies.

This paper gives descriptions of the four new taxa and updates the key to *Goodenia* species given in the “Flora of Australia” (Carolin 1992). Three of the four new taxa have conservation priority although future surveys may find them to be more common than the current collections at the Western Australian Herbarium (PERTH) reflect due to the poorly collected regions in which they occur.

Taxonomy

Goodenia crenata Carolin & Sage, *sp. nov.*

Species haec ab *Goodeniae stellatae* Carolin praecipue differt pilis non-stellatis et alis loborum corollae latioribus.

Typus: Glass Hill, East Kimberley [precise locality withheld for conservation purposes], Western Australia, 7 June 1999, D.J. Edinger 1416 (*holo*: PERTH 05373255).

Perennial herb with stout tap-root and an ascending rosette of basal leaves. *Stems* prostrate to decumbent, up to 10 cm long, terete or slightly angled, pubescent-hirsute with long simple hairs and some minute glandular hairs. *Leaves basal*, oblong-elliptic to narrowly obovate, 6–8 cm long, 1–2 cm wide, pubescent-hirsute, crenate, obtuse, tapering very gradually into an indistinct petiole with a slightly broadened base usually obscuring the tuft of short axillary hairs; *cauline leaves* smaller and more distinctly sessile. *Inflorescence* a leafy raceme; bracts leaf-like but smaller and broader; peduncles 5–15 mm long, pubescent-hirsute, articulate immediately below the ovary; bracteoles absent. *Sepals* lanceolate, c. 4 mm long, 0.5 mm wide, pubescent with simple hairs, entire, obtuse to acute. *Corolla* yellow, c. 15 mm long, pubescent with simple hairs outside and with a few scattered simple hairs inside; anterior pouch c. ½ as long as the ovary: tube c. 3 mm long: lobes unequal; superior lobes narrowly oblong, c. 9 mm long, 0.5–0.8 mm wide with a wide (c. 2 mm) wing on either side the lower wing passing into a long \pm barbate distinct auricle; inferior lobes oblong-elliptic, c. 5 mm long, c. 1.5 mm wide with a broad (c. 2 mm) wing on either side just over ½ as long as the lobe and making an obtuse angle at the apex with each other. *Stamen filaments* linear, c. 2 mm long. *Anthers* oblong, c. 1 mm long, c. 0.5 mm wide. *Ovary* pubescent; style c. 6 mm long almost glabrous, indusium truncate-obdeltoid, c. 1.5 mm long, c. 1.5 mm wide, brownish, convex above with a slight keel, with a slightly curved orifice beset with white bristles scarcely 0.5 mm long on both lips. *Fruit* broadly ovoid c. 6 mm diam., seeds circular, 3.5–4 mm long including the narrow wing, wing c. 0.5 mm wide, \pm smooth, black or very dark brown. (Figure 1A,B)

Other specimens examined. WESTERN AUSTRALIA: Slaty Creek, north Tanami Desert, K.F. Kenneally 11997 (PERTH); Halls Creek, G.W. Carr 3503 & A.C. Beauglehole 47281 (PERTH); Nicholson Homestead, T.E.H. Aplin 5379 (PERTH).

Distribution. Known only from scattered collections in the Ord–Victoria Plains and Central Kimberley Interim Botanical Regions of the Northern Botanical Province (Halls Creek, Nicholson Station and Slaty Creek) and the Tanami Interim Biogeographic Region of the Eremaean Botanical Province (Thackway & Cresswell 1995). (Figure 2A)

Habitat. Found mostly beside water holes, creeks and rocky outcrops in red sand.

Flowering period. Collected flowering in May and July.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Three. Though occurring in a poorly collected region of Western Australia, the few collections, and preference for water bodies, subject it to the threat of ‘water point’ degradation by station cattle.

Etymology. From Latin – *crenatus*, referring to the rounded teeth (crenate) of the leaf margins.

Notes and affinities. This species was treated as *Goodenia* sp. C in “Flora of the Kimberley Region” (Wheeler 1992) and has been allocated the phrase name *Goodenia* sp. Halls Creek (G.W. Carr 3503).

Related to *G. stellata* Carolin but distinguished by simple rather than stellate hairs and wider corolla lobe wings. Vegetatively similar to *G. cycloptera* R. Br. but the sepals are broader in shape and the anterior pouch of the corolla is very much shorter and not at all prominent.

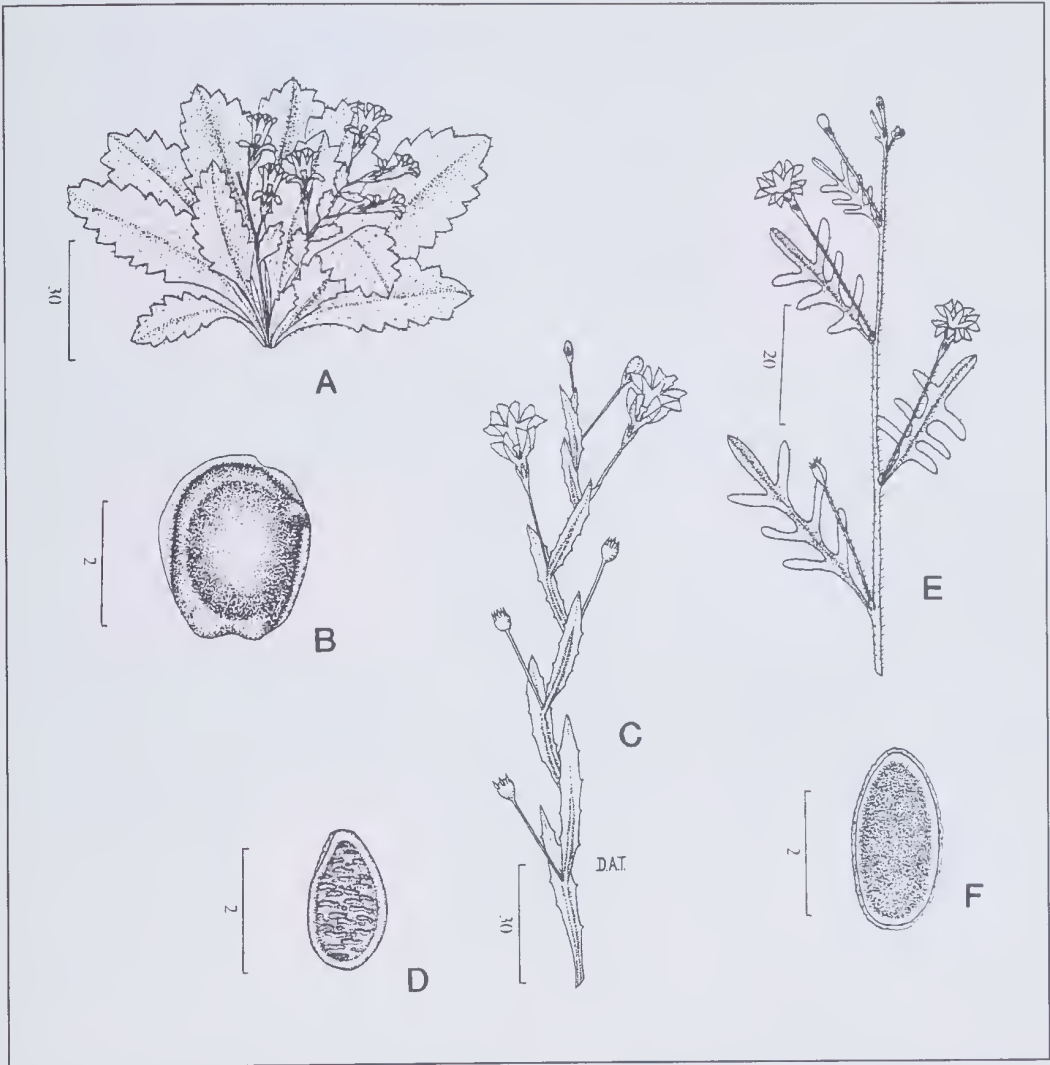


Figure 1. A,B. *Goodenia crenata* A – habit; B – seed. C,D. *Goodenia inundata* C – habit; D – seed. E,F. *Goodenia psammophila* E – habit; F – seed. Reproduced with permission from Wheeler *et al.* (1992): Figures 274–276. Scale bars are in mm.

The senior author, Dr Roger Carolin, previously of the John Ray Herbarium (SYD), is an eminent authority on the Goodeniaceae family.

Goodenia inundata* Sage & Pigott, *sp.nov.

Goodeniae malvinae Carolin affinis sed caulis fractiflexis per basibus foliorum decurrentibus semper alatis, et seminibus minoribus testis rugosis.

Typus: Kalumburu Road [precise locality withheld for conservation purposes], Western Australia, 21 June 1993, I. Cowie & L. Craven IC 4188 (*holo:* PERTH 04063759; *iso:* DNA, MEL).

Erect *ephemeral or annual herb*, 15–34 cm high, with scattered, simple appressed hairs to almost glabrous. *Stems* single to multiple, flexuose, winged by decurrent leaf bases. *Leaves* cauline, decurrent, leaf with free part narrowly ovate, 15–30 mm long, 4–9 mm wide, becoming smaller up the stem, sparsely hairy to glabrous, entire to minutely toothed. *Inflorescence* a leafy panicle; pedicels 10–25 mm long, with sparse appressed hairs, ebracteolate. *Sepals* narrowly elliptic-triangular or narrowly ovate, 3.0–5.1 mm long, sparsely hairy, apex acute. *Corolla* purple or maroon with a yellow centre, 14–18 mm long, articulate below ovary; tube 3.7–4.1 mm long; pouch obscure or obsolete; sparsely hairy outside, dense patch of simple hairs inside, calli present. *Abaxial corolla lobes* 4.7–6.3 mm long, 1.3–2.2 mm wide, fused for 3.5–4.1 mm further than the adaxial corolla lobes; wings 5.3–7.3 mm long, 1.8–2.2 mm wide, erose. *Adaxial corolla lobes* c. 9 mm long, c. 1.5 mm wide, ‘kinked’ below auricle, auricle 2.2–2.8 mm long, 1.6–2.2 mm wide; wings 5.7–7.0 mm long, 2.0–2.2 wide above auricle, 1.9–2.5 mm wide opposite auricle. *Stamen filaments* linear, 2.9–3.6 mm long. *Anthers* c. 1.5 mm. *Ovary* c. 3 mm long; septum about the same length as ovary; ovules c. 12, in 2 rows in either side of septum; scattered hairs along sepal bases. *Style* c. 6.0 mm long, glabrous or with scattered simple hairs; indusium broader than long, with a long tuft of simple hairs underneath to c. 2 mm and simple hairs above and below, bristles on upper lip c. 0.2 mm long, bristles on lower lip c. 1 mm. *Fruit* globular, 3.5–4 mm long, 3.5–4 mm wide, very sparsely hispid. *Seeds* elliptic, c. 2 mm long, c. 1 mm wide, thick; body rugose with a smooth margin; wing obsolete. (Figure 1C,D)

Other specimens examined. WESTERN AUSTRALIA: Gibb River–Kalamburu Mission road, McDonald Creek, A.C. Beauglehole ACB 52186 (PERTH); 25 km WSW of Theda turnoff, N Kimberley, D.J. Edinger 756 (PERTH); King Edward River, c. 100 km S of Kalumburu, G.J. Keighery 9043 (PERTH); King Edward River, c. 100 km of Kalumburu, G.J. Keighery 9089 (PERTH); “Dog Leg Swamp”, 35 km SE of Amax Campsite on Theda Station road, W Kimberley, K.F. Kenneally 6727 (PERTH, CANB, K, L); King Edward River Crossing campsite, K.F. Kenneally 11450 (PERTH, DNA); c. 1 km NW of Kalumburu Mission c. 200 m W of EW strip of the aerodrome, A.A. Mitchell 3941 (PERTH, BROOME, NSW); camping area near Mitchell Plateau road crossing of King Edward River, N Kimberley, A.A. Mitchell 4382 (PERTH, BROOME, NSW).

Distribution. Occurring in seasonally inundated areas in the north west of the Northern Kimberley Interim Botanical Region (Thackway & Cresswell 1995), of the Northern Botanical Province, between the Mitchell River and Theda Station. (Figure 2A)

Habitat. Found in herb fields on shallow pockets of soil on temporarily inundated areas of sandstone along watercourses.

Flowering period. Collected flowering in May, June and August.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Two. Known from only four populations and may prove to be more common than is apparent from the current collections due to its occurrence in a very poorly collected region.

Etymology. From the Latin – *inundatus*, alluding to the seasonally inundated habitat of the species.

Notes and affinities. Closely related to and previously included within the concept of *Goodenia malvina* Carolin but treated as *G. sp. A* in the “Flora of the Kimberley Region” (Wheeler 1992) and subsequently known by the informal name *Goodenia sp. A* Kimberley Flora (G.J. Keighery 9043). Readily distinguished from *G. malvina* by having flexuose stems always winged by decurrent leaf bases and smaller seeds which are scarcely winged.

The co-author, Julian Patrick Pigott, formerly of the Western Australian Herbarium, is currently employed by the Weeds Cooperative Research Centre in Frankston, Victoria.

Goodenia psammophila* Sage & M.D. Barrett, *sp. nov.

Goodeniae coronopifoliae R.Br. affinis sed corolla minore et seminibus minoribus et vix alatis.

Typus: east of Mt Agnes, West Kimberley [precise locality withheld for conservation purposes], Western Australia, 19 March 1998, *M.D. Barrett* 401 (*holo*: PERTH 05518180; *iso*: DNA, K).

Prostrate or erect *annual herb*, sparsely hispid, sometimes with dark-headed glandular hairs. *Stems* multiple, terete. *Leaves* narrowly lanceolate to narrowly obovate, 10–91 mm long, 3–22 mm wide, entire to denticulate to pinnatisect, sparsely hairy, cauline leaves becoming linear and entire towards apex, apex \pm acute, base attenuate. *Inflorescence* a leafy raceme; pedicels 11–37 mm long, sparsely hairy with hairs sometimes concentrated on one side, ebracteolate. *Sepals* narrowly elliptic to linear, *c.* 1–2.1 mm long, glabrous or sparsely hairy mostly on margins, \pm equal, apex rounded to acute. *Corolla* yellow with brownish-purple or white-yellow adaxial lobes, 6.5–9.2 mm long, articulate immediately below ovary; pouch obscure or obsolete; dense, long simple hairs inside the throat and scattered simple hairs outside; long simple hairs on the corolla lobe margins. *Abaxial corolla lobes* *c.* 3 mm long, *c.* 1.3 mm wide, fused for a further *c.* 3 mm than adaxial corolla lobes; wings 2.6–3.6 mm long, *c.* 1.5 mm wide, entire. *Adaxial corolla lobes* *c.* 5 mm long, *c.* 1 mm wide; wings *c.* 2–2.7 mm long, 0.7–1.2 mm wide, wing above auricle and opposite \pm equal. *Stamen filaments* linear, *c.* 1.5 mm long; anthers *c.* 1 mm long. *Ovary* *c.* 1 mm long, sparsely hispid; ovules *c.* 2. *Style* \pm glabrous; indusium *c.* 1 mm long, *c.* 1.5 mm wide, with a double groove above, long simple hairs above and below with one tuft of long simple hairs below, bristles on lips *c.* 0.2 mm long and \pm equal. *Fruit* ellipsoid, 3.5–5 mm long, sparsely hairy. *Seeds* elliptic, *c.* 3 mm long, *c.* 1.5 mm wide, thick, reticulate-foveate, brown/tan, rim raised but not discriminated from body, scarcely winged or wing obsolete. (Figure 1E,F)

Etymology. From the Greek – *psammophilus* (sand loving), for the occurrence of the species in sand, mostly on sandstone pavement.

Notes and affinities. Treated as *Goodenia* sp. B in “Flora of the Kimberley Region” (Wheeler 1992) and subsequently known as *Goodenia* sp. B Kimberley Flora (*K.F. Kenneally* 7751). Superficially similar to *G. coronopifolia* R.Br. but distinguished by a lower number of ovules (2 instead of 4–8), fruit that is ellipsoid rather than globular and seeds that are elliptic rather than orbicular. It is distinctive because of the indusium that has a double groove and seeds that are thick and scarcely winged or obsolete. The typical subspecies occurs on sand flats over sandstone pavements, while subspecies *hiddinsiana* is found mostly in tall grasslands.

The co-author, Matthew D. Barrett, of the Kings Park Botanic Garden (KPBG), was previously of Beverley Springs Station in the Kimberley Region.

Key to subspecies of *Goodenia psammophila*

- 1 Long eglandular hairs only; basal (or near basal) leaves lobed to pinnatisect; habit prostrate subsp. ***psammophila***
1. Dark headed glandular hairs present on pedicels and ovary; basal (or near basal) leaves mostly entire to lobed; habit mostly erect subsp. ***hiddinsiana***

Goodenia psammophila* Sage & M.D. Barrett subsp. *psammophila

Prostrate herb with eglandular hairs. *Basal (or near basal) leaves* lobed, toothed to pinnatisect. *Adaxial corolla lobes* brownish-purple.

Selected specimens examined. WESTERN AUSTRALIA: N of Charnley River crossing, *M.D. Barrett* 42 (PERTH); N of the junction of Youwanjela Creek and Prince Regent River, Kimberley Region, *M.D. Barrett* 613 (PERTH); Bachsten Creek Gorge, *M.D. Barrett* 697 (PERTH); Bachsten Creek, *M.D. Barrett* 728 (PERTH); NW of Mitchell River Falls, Mitchell Plateau, N Kimberley, *K.F. Kenneally* 7751 (PERTH, SYD).

Distribution. Known from the Edkins Range north through to the Prince Regent River and the Mitchell Plateau in the North Kimberley Interim Biogeographic Region (Thackway & Cresswell 1995). (Figure 2B)

Habitat. Known from sandy flats on sandstone pavement and sandstone ridges.

Flowering period. Collected in flower in January, February and March.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Three. May prove to be more common than is currently apparent.

***Goodenia psammophila* subsp. *hiddinsiana* Sage & M.D. Barrett, subsp. nov.**

A subsp. *psammophila* pilis glandularibus fusci-capitatis ornatis, lobis adaxialibus corollae luteis vel albis, habito plerumque erecto, foliis basalibus plerumque integris differt.

Typus: Bachsten Creek [precise locality withheld for conservation purposes], Western Australia, 4 February 1999, *M.D. Barrett* 782 (*holo:* PERTH 05518172; *iso:* DNA, K)

Erect herb with dark-headed glandular hairs on the pedicels and ovary. *Basal (and near basal) leaves* mostly entire to lobed. *Adaxial corolla lobes* mostly yellow or white (brownish purple).

Selected specimens examined. WESTERN AUSTRALIA: Prince Regent River Reserve, *M.D. Barrett* 748 (PERTH); Edkins Range, N of Beverley Springs Homestead, *R.L. Barrett* 644 (PERTH); E of Beverley Springs Homestead, *R.L. Barrett* 924 (PERTH); mouth of the Berkley River, *K.F. Kenneally* 11306 (PERTH, NSW).

Distribution. Currently known only from the vicinity of the Beverley Springs Station homestead, Edkins Range and Bachsten Creek in the Northern Kimberley Interim Biogeographic Region (Thackway & Cresswell 1995) of the Northern (Kimberley) Botanical Region. (Figure 2C)

Habitat. Occurs in tall, sandy grasslands besides creek lines or below sandstone ridges.

Flowering period. Known to flower from December to February.

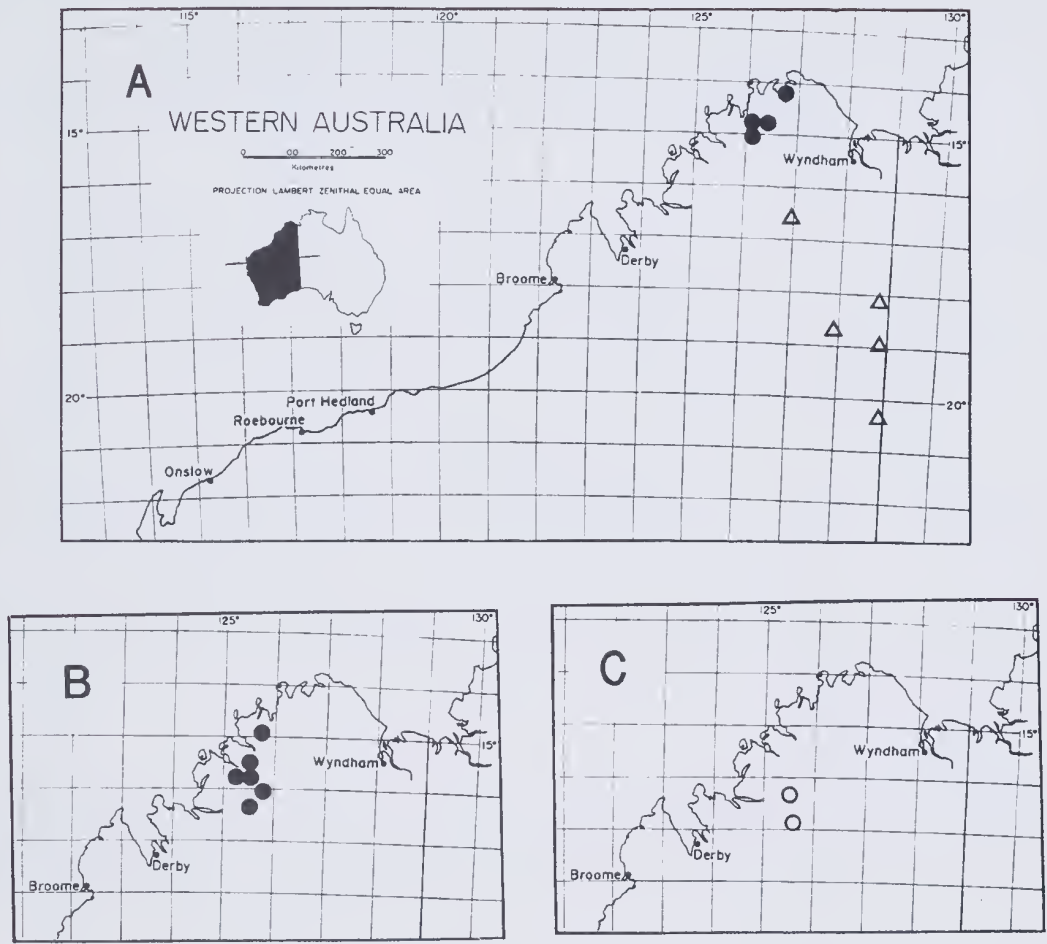


Figure 2. Distribution maps. A – *Goodenia crenata* Δ and *G. inundata* \bullet ; B – *G. psammophila* subsp. *psammophila*; C – *Goodenia psammophila* subsp. *hiddinsiana*.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Two. Known from only three collections, all over a range of less than 100 kilometres. Collected only by the second author and his brother, requiring further surveys to locate other possible populations.

Etymology. The epithet honours Major Les Hiddins (also known as The Bush Tucker Man) of the Australian Army, soldier, bushman, historian and explorer.

Notes. Distinguished from the typical subspecies by an erect habit, dark headed glandular hairs on the pedicels and ovary, basal (and near basal) leaves mostly entire to lobed and adaxial corolla lobes mostly yellow or white (brownish purple). Found mostly in tall grasslands rather than the sandy flats on sandstone pavement and sandstone ridges the typical subspecies occurs on.

Amendments to key to *Goodenia* species in "Flora of Australia"

For *Goodenia crenata* the key should be altered to read from couplet 20 in Group 7 (Carolin 1992: 162–163).

20 Leaves entire, dentate or crenate (sometimes lobed towards the base in *G. iyouta*)

20a Leaves crenate *G. crenata*

20a: Leaves entire or dentate

For *G. inundata* the key should be altered to read from couplet 18 in Group 6 (Carolin 1992: 159–160).

18 Corolla 6–7 mm long; sepals adnate to ovary only near the base *G. salmoniana*

18: Corolla over 8 mm long; sepals adnate to ovary for at least ½ its length

18a Corolla yellow; leaf bases not decurrent *G. lunata*

18a: Corolla purple or maroon with a yellow centre; leaf bases decurrent *G. inundata*

For *G. psammophila* the key should be altered to read from couplet 1 in Group 7 (Carolin 1992: 162–164). This species may also key out to couplet 28. See the treatment above for the key to subspecies.

1 Indusium notched, with a furrow or a double groove on the upper surface

2 Indusium folded with a furrow on upper surface *G. odonnellii*

2: Indusium notched or with a double groove, not folded

3 Corolla 12–25 mm long *G. mimuloides*

3: Corolla less than 10 mm long

3a Ovules 4–6; SW Australia *G. pusilliflora*

3a: Ovules c. 2; Kimberley Region *G. psammophila*

Acknowledgements

The author is grateful to Paul Wilson for assistance with the Latin diagnoses, Dr Barbara Rye for her assistance with the manuscript, Dr Roger Carolin for his thoughts and insight (senior author of *Goodenia crenata*), Patrick Pigott for his continual support and encouragement (co-author of *G. inundata*) and Matthew Barrett (co-author of *G. psammophila* and subspecies) for his cooperative work.

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Solanum oligandrum (Solanaceae), a new species from the Great Sandy Desert, Western Australia

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Abstract

Symon, D.E. *Solanum oligandrum* (Solanaceae), a new species from the Great Sandy Desert, Western Australia. *Nuytsia* 13(3):537–541 (2001). *Solanum oligandrum* Symon, of sect. *Pugiunculifera* Symon, is described from dried and cultivated material. It occurs in depressions and interdune corridors of the Great Sandy Desert of Western Australia. An illustration and distribution map are also provided.

Introduction

The first collections of this species of *Solanum* L. (Solanaceae) appear to have been made by T. Fatchen in 1984. The two specimens were located with latitude and longitude only, which placed them in undifferentiated sand dunes. They were tentatively identified as *S. pugiunculiferum* C.T. White but were recognized as being geographically and ecologically disjunct from that species.

A more recent herbarium and seed collection of the taxon (Dureau *et al.* WEC2–19) has enabled observations of fresh cultivated material and a reassessment of its status to be made. It is here described as a new species.

Taxonomy

Solanum oligandrum Symon, *sp. nov.*

Herba annua aut breviter perennis ad 1 m alta. Caules virides glabri fortiter armati spinis erectis rectis pallidis 2–20 mm longis. Folia ad 7 x 6 cm, late elliptica ambitu sed profunde pinnatifida cum 1–3 paribus suboppositis lobis; lamina ad 4 mm lata, lobis ad 2.5 x 0.4 cm spinis sparsis. Inflorescentia reducta pulvino internodali, aliquot flores masculinas supra 1(2) flores as bisexuales ferenti. Pedicellus 3–4 mm; calyx 6–8 mm longus, lobis lanceolatis, aculeatus. Corolla ad 14 mm longa, stellata rotata circa ad dimidium longitudinis divisa, pilis brevibus atris glandularibus versus basim, malvina, extra pilis stellatis dense pubescens. Filamenta 1–1.5 mm. Antherae 6.5 mm longae, linear lanceolatae

poricidiles. Ovarium floris fertilis 2 mm, late conicum, glabrum. Stylum ad 11 mm sigmoidium. Flores masculinae ovario et stylo vestigiali aut absenti. Bacca c. 10 mm diam. globosa, viridis, parum siccata. Semina 2–2.5 mm diam., discoidea, minute granulata, fusea ad picea.

Typus: one metre prickly shrub with mauve flowers, saline ‘bulldust’ with algal crust over calcrete, swales seasonally inundated, Mandoora Marsh area IBRA, Great Sandy Desert, 19°45'20"S, 121°26'55"E, Western Australia, 16 October 1999, D. Dureau, T. Handasyde, T. Willing WEC2–19 (*holo*: PERTH; *iso*: AD).

Annual or short-lived *perennial* to 1 m, erect, sparsely branched, stems green, glabrous, possibly glaucous, strongly armed with erect, straight, straw-coloured prickles 2–20 mm long. *Leaves* to 7 cm long, glabrous, deeply pinnately parted with 1–3 pairs of sub-opposite lobes, with all stages of reduction in the upper leaves to a lanceolate leaf with single shallow lateral lobe. *Petiole* with narrow green flange; lamina to 4 mm wide, midrib well developed; 1–3 lobes to 3 cm long, linear triangular, to 4 mm wide, sometimes the lobes with 1 or 2 short shallowly triangular lateral lobes 2–3 mm long; all with straight pale prickles to 1 cm long. *Inflorescence* a leaf-opposed or internodal short cyme c. 3 mm long, mostly reduced to a pulvinus bearing several male flowers above 1(2) bisexual flowers. *Pedice* 3–4 mm long. *Calyx* 6–8 mm long, lobes lanceolate, each with 1–3 conspicuous prickles. *Corolla* stellate-rotate, divided for about half its length, to 14 mm long in bisexual flower, smaller (to 11 mm long) in male flowers, mauve, with scattered dark, short, glandular hairs on the tube within at the insertion of the filaments, densely pubescent outside with short stellate hairs. *Filaments* 1–1.5 mm long. *Anthers* c. 6.5 mm long, linear-lanceolate, poricidal. *Ovary* (fertile flower) c. 2 mm long, broadly conical, glabrous. *Style* c. 11 mm long, sigmoidal, in male flowers ovary and style lacking or vestigial. *Berry* somewhat flattened globose, c. 10 mm diam., apparently dryish, green at maturity (only dried material seen). *Seeds* 2–2.5 mm diam., discoidal, minutely granular, dark brown to black. *Cotyledons* lanceolate c. 2 x 8 mm, shiny green, petiole 2–3 mm long. (Figure 1)

Other specimens examined. WESTERN AUSTRALIA: herbaceous perennial, erect, 30 cm, in soakage area in interdune corridor, 19°40'S, 124°40'E (Crossland sheet), 25 May 1984, *Fatchen* 900 (AD); erect shrub on calcareous interdune swale, 19°58'S, 125°22'E (Crossland sheet), 27 May 1984, *Fatchen* 980 (AD).

Distribution. Western Australia: Three widely separated collections from the Great Sandy Desert are known, the first two located on the Crossland sheet (Aust. 1:250,000 series) and the third further west on the Mandora sheet and approximately 50 km E of the Sandfire Roadhouse on the main coastal highway on the Eighty Mile Beach. All collections have been made from interdune depressions. (Figure 2)

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Three. Only known from three widely spaced collections in the huge expanse of the Great Sandy Desert. Pastoral activity is light to non-existent over much of the area and the apparently scattered populations of this species are probably safe, though no assessments have yet been made.

Etymology. From the Greek –*oligos*, in the sense of few, and –*andros*, meaning male. The epithet refers to the few male flowers above the bisexual flower.

Cultivated material. Several plants have been grown from seed from the *Dureau et al.* collection. These were established in pots in the open. In these cultivated plants the leaves were a shiny green close to RHS green group 141B, glabrous, not glaucous, firm, somewhat thick and almost succulent. They bore

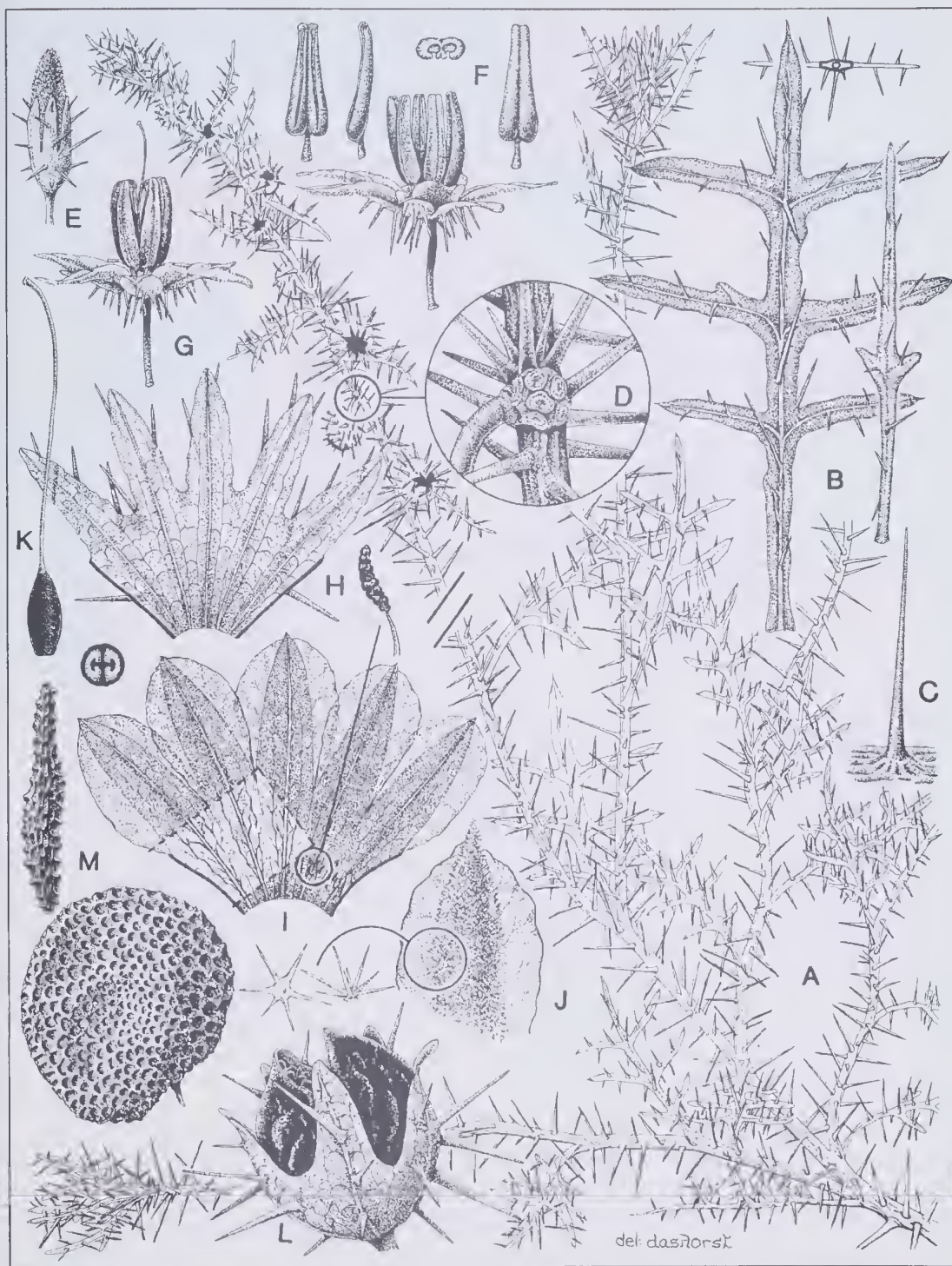


Figure 1. *Solanum oligandrum*. A – branch (x5); B – mid and upper leaf (x2); C – prickly stem (x2); D – pulvinus with pedicel scars of male flowers and bearing one fruit (x5); E – bud (x4); F – male flower and anthers (x3); G – bisexual flower (x3); H – calyx (x6); I – corolla (x3.5); J – corolla lobe and outer pubescence (x6); K – ovary and style (x5); L – dried fruit (x3); M – two views of seed (x16). Drawn by G.R.M. Dashorst from D. Dureau et al. WEC 2–19.

straight, erect, straw-coloured prickles to 5–6 mm long on the veins above and below. The plants branched freely at the lower nodes and commenced flowering at 20 cm high. The flowers opened a pale violet-blue and deepened to violet-blue RHS 91A. The corolla had a yellowish star at the base visible on both sides of the tube and the anthers were loosely erect.

Of particular interest were the brownish, multicellular glands at the base of the corolla, which were roughly cylindrical and borne on a filament. These have not been observed in other Australian species of *Solanum*.

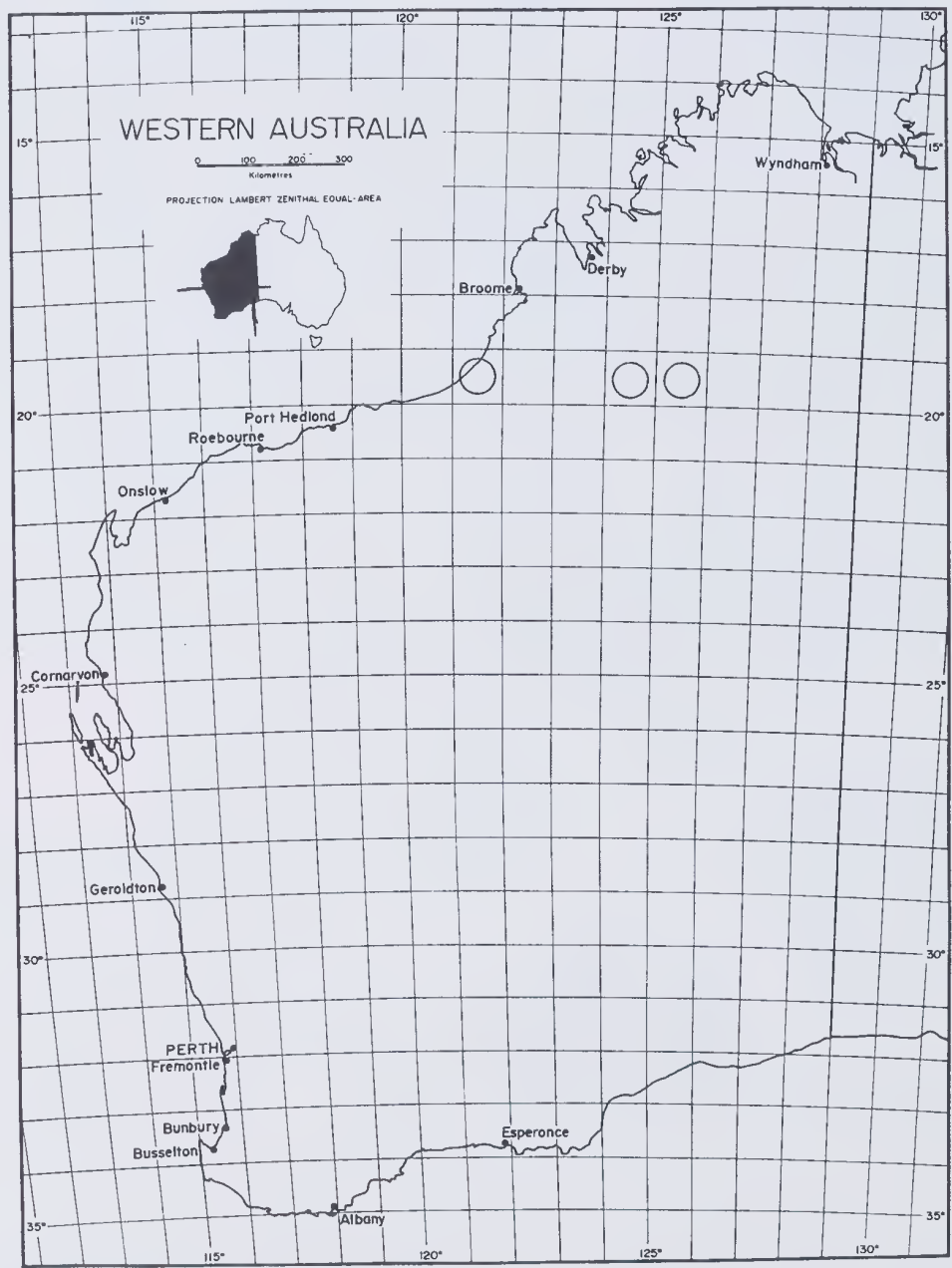


Figure 2. Distribution of *Solanum oligandrum*.

Diagnostic features. The new species is distinct from all other Australian *Solanum* species by the combination of its glabrous nature, the abundant straight straw-coloured prickles and the inflorescence reduced to a pulvinus.

Notes. The new species appears related to *S. pugiunculiferum* from northern Northern Territory and Queensland. It agrees in the lack of pubescence (except on the corolla), the conspicuous pale, straight prickles, and the dryish green fruits. For that species I erected the new section *Pugiunculifera* Symon (1981), and *S. oligandrum* can also be accommodated in that section. The long tapered poricidal anthers and the presence of stellate hairs on the corolla clearly place the new species in the subgenus *Leptostemonum* (Dunal) Bitter.

The new species differs from *S. pugiunculiferum* in its sessile lanceolate rather than petiolate linear cotyledon; its more deeply and narrowly lobed leaves; the reduction of the inflorescence; the development of several male flowers above one bisexual flower; the much longer calyx; the stellate-rotate rather than rotate shallowly-campanulate corolla; the dense stellate outer pubescence on the corolla; the clearly developed long poricidal anthers and the minutely granular discoidal seed, 2–2.5 mm diam. rather than the flat distinctly winged seeds c. 3 mm diam.

The inflorescence in *Solanum* is basically a cyme which may be elaborated to panicate form or reduced to a small, simple cyme and in extreme cases to a vermiform axis or a pulvinus. No other Australian species of *Solanum* has a similar inflorescence. However, reduction of the inflorescence to a pulvinus does occur in *Lycianthes* (Dunal) Hassler (Symon 1985), which may also have several male flowers above the bisexual ones.

The production of extra male flowers parallels the development of androdioecy and dioecy in a number of species of *Solanum*, e.g. *S. dioicum* W. Fitzg., *S. leopoldensis* Symon, *S. oedipus* Symon, *S. phlomoides* A. Cunn. ex Benth. and *S. tudununggae* Symon, although none of these species are closely related to *S. oligandrum*. These species (and possibly also *S. oligandrum*) are pollinated by solitary bees which ‘buzz’ the anthers to release pollen. The supply of abundant male flowers would seem to contribute to the welfare of the bees, in turn essential to pollinate the *Solanum* flowers (Anderson & Symon 1988).

Acknowledgements

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Reinstatement and revision of *Euryomyrtus* (Myrtaceae)

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Abstract

Trudgen, M.E. Reinstatement and revision of *Euryomyrtus* (Myrtaceae). *Nuytsia* 13(3): 543–566 (2001). *Euryomyrtus* Schauer is reinstated and lectotypified. A revision of the genus with descriptions, maps, illustrations and a key is presented. Seven species are recognized for the genus which is endemic to southern Australia, including Tasmania. *Euryomyrtus denticulata* (Maiden & Betche) Trudgen, *E. leptospermoides* (C.A. Gardner) Trudgen, *E. maidenii* (Ewart & Jean White) Trudgen, *E. ramosissima* (A. Cunn.) Trudgen and *E. ramosissima* subsp. *prostrata* (Hook. f.) Trudgen are new combinations, and *E. inflata* Trudgen, *E. patrickiae* Trudgen and *E. recurva* Trudgen are new species. The closest relatives of the genus are considered to be in a natural group which includes *Rinzia* Schauer, *Hypocalymma* Endl., *Ochrosperma* Trudgen and *Triplarina* Raf.

Introduction

As noted in previous papers (Trudgen 1986, 1987), the heterogenous assemblage of species that have traditionally been placed in the subtribe Baeckinae of the Myrtaceae show significant variation in the morphology of the seeds, fruits and anthers. It was also noted that three supra-generic groups exist within this variation. *Euryomyrtus* belongs in one of these three groups (which also contains *Rinzia* Schauer, *Hypocalymma* Endl., *Ochrosperma* Trudgen, *Triplarina* Raf., *Baeckea crassifolia* Lindl., *B. ericaea* (F. Muell.) Benth., *B. polystemona* F. Muell., *B. tetragona* F. Muell. ex Benth. and some undescribed species) the members of which have “reniform seeds with or without an aril, anthers opening in slits and external filament glands” (Trudgen 1986) and aborted ovules which do not develop into ovulodes.

Euryomyrtus is reinstated here and its seven species are revised. It is distributed in south-western and south-eastern Australia.

Taxonomic history

Euryomyrtus was described by Schauer (1843) who placed it in the tribe Baeckeeae, along with twelve other genera that he recognized for this tribe. Bentham (1867) rejected nine of these genera, synonymizing them with *Baeckea* L., although he maintained some of them, including *Euryomyrtus*

and *Rinzia*, as sections of that genus. He placed *Baeckea* in the subtribe "Baeckeeae" of the tribe *Leptospermeae* with *Scholtzia*, *Hypocalymma*, *Astartea* DC. and *Balaustion* Hook.

Niedenzu (1898) maintained *Euryomyrtus* as a section of *Baeckea* (in which he also included *Astartea* and *Scholtzia* as sections) but transferred the related species Bentham had placed in section *Rinzia* to *Hypocalymma*. He thus recognized that *Rinzia* and *Hypocalymma* are related but failed to recognize that the species Bentham placed in his section *Euryomyrtus* are more closely related to these genera than to the remainder of *Baeckea* as circumscribed by Bentham. Bean (1995, 1997) recognized that *Euryomyrtus* should be considered generically distinct but did not formally reinstate it or lectotypify it.

In their informal classification of the Myrtaceae, Briggs & Johnson (1979) placed *Baeckea* in the *Baeckea* suballiance of their *Chamelaucium* alliance, with *Euryomyrtus* as a section requiring investigation to see if it deserved generic rank. They subsequently (Johnson & Briggs 1985) abandoned suballiances in the *Chamelaucium* alliance and presented a sketch phyllogram of relationships within this difficult group.

Materials and methods

This study was based on the gross morphology of herbarium material supplemented by some observations in the field. The measurements given for the parts of flowers were taken from material that had been boiled in water with a small amount of detergent in it. The measurements of leaves were taken from dry material. A selection of the material examined has been cited, based on location (to cover the range of the species), quality of label information and variation. For poorly collected species all the material seen has been cited.

Terminology. Processes (Trudgen 1986) are the same structures referred to by Carr (1980) as floral trichomes. They also occur in at least some *Rinzia* species and some other members of the natural group to which *Euryomyrtus* belongs.

The inflorescence terms anthopodium, monad, uniflorescence, conflorescence, superconflorescence, brachyblast, auxotelic and anauxotelic are used as defined by Briggs & Johnson (1979). Aril, hypanthium and flower size are used as defined in Trudgen (1986). Testa surface terminology follows Murley (1951) as given in Stearn (1973).

Separation of *Euryomyrtus* from related genera

Within the supra-generic group having reniform seeds, the seven species referred here to *Euryomyrtus* form a coherent subgroup that is sufficiently distinct to deserve generic rank. *Euryomyrtus* can be distinguished from the other members of the reniform-seeded group by having the following combination of characters:

1. Filaments terete (sometimes slightly flattened near the base) and the stamens opposite the petals with longer filaments than those opposite the sepals and between the sepals and petals.
2. Anthers dorsifixed and versatile.

3. When stamen number is reduced, then those stamens opposite the sepals and/or between the sepals and petals are lost rather than those opposite the petals (some of which are lost in *E. ramosissima* subsp. *prostrata* when there are less than 5 stamens).
4. Seeds arillate (the aril in *E. leptospermoides* is very small and may sometimes be absent).
5. Seed testa light brown to brown in colour, except for *E. leptospermoides* in which it is a pale straw colour.
6. Seed hilum small.
7. Flowers with a well developed anthopodium (except *E. inflata*) and a definite (at least 0.5 mm) to well developed peduncle.
8. Bracteoles persistent, subopposite to alternate, broad and overlapping at the base.
9. Brachyblasts bearing 2–4 monads are the predominant inflorescence structure occurring in all species except *E. maidenii* and *E. patrickiae*, which has only axillary monads (these also occur in other species). The brachyblasts are mostly terminal but also occur in leaf axils, particularly when specimens are heavily in flower.
10. The lower 1/3–3/4 of the ovary is fused to the hypanthium.
11. The fruit opens widely (except in *E. inflata*).

Although they are not the only differences, the first two characters separate *Euryomyrtus* from *Rinzia*, the species of which have flat filaments with the anthers attached to their adaxial surface. *Hypocalymma* can also be separated from *Euryomyrtus* on stamen characters as the species referred to it have basifixed anthers.

The arrangement of the stamens in *Euryomyrtus* separates it from *Ochrosperma* and *Triplarina*, which have the stamens predominantly opposite the sepals rather than predominantly opposite the petals. There are also differences in the seeds, as the seeds of species referred to *Ochrosperma* have a pale straw-coloured testa with the papillae arranged in rows while the seeds in *Triplarina* have a reddish testa (my observations for some of the species) or brown testa (as described by Bean 1995) and no aril.

Baeckea tetragona and two allied undescribed species (all three endemic to the south-west of Western Australia) can be easily separated from *Euryomyrtus* on hypanthium and fruit characters. Whereas in *Euryomyrtus* the hypanthium is usually about as broad as long and the fruit opens widely with prominent valves (except in *E. inflata*), in *B. tetragona* and its allies the hypanthium is longer than broad and the fruit does not open widely and does not have prominent valves. The *B. tetragona* group can also be distinguished from *Euryomyrtus* by its smaller seeds without an aril, and its inflorescence is consistently of axillary monads whereas most *Euryomyrtus* species have brachyblasts predominating.

The remaining species (*Baeckea crassifolia*, *B. ericaea*, *B. polystemona* and an undescribed species from the south-west of Western Australia) in the larger group to which *Euryomyrtus* belongs can be separated from it on the following basis. All have very reduced peduncles (0.1–0.3 mm); where the

seed is known (no seed of the undescribed species has been seen) it does not have an aril and the papillae on the testa are very small (barely distinguishable at $\times 10$); the seeds of two of the species (*B. crassifolia* and *B. ericaea*) have a large hilum (c. 1/3 of the length of the seed); while variable (between the species) the bracteoles are dissimilar to those found in *Euryomyrtus* and are opposite rather than sub-opposite/alternate; in three of the species the calyx lobes are infolded after flowering, whereas in *Euryomyrtus* they are not; finally in these four species the inflorescence is consistently of axillary monads and brachyblasts are not present.

Systematic position of *Euryomyrtus*

Briggs & Johnson (1984: 747, figure 10) presented a "sketch phylogram" of their interpretation of relationships within their *Chamelaucium* alliance developed from the information then available to them. This phylogram has six evolutionary lines arising from a putative "standard" ancestor described as "hairs lost, ovary 3-locular, [inflorescence] metabotyoid, hypocotyl > cots." (commas added). One of these six lines has only *Hypocalymma* on it, another only *Balaustion* and a third is more complex with branches for five genera: *Baeckea*, *Astartea*, *Baeckea*, *Thryptomene*, *Micromyrtus* and *Corynanthera*. It has more than one branch to *Baeckea*, to show (as Briggs & Johnson indicated in their text) that *Baeckea* was considered to include more than one genus.

Subsequently, Trudgen (1986, 1987) described the existence of a distinctive seed type in *Rinzia*, *Ochrosperma* and related genera that has a reniform shape, a crustaceous testa and is often arillate. The existence of seeds with this combination of characters has significant implications for unravelling the evolutionary history of the *Chamelaucium* alliance, as in the absence of evidence to indicate otherwise, it should be considered to have only arisen once. To emphasize the importance of this seed type in understanding the phylogeny of the *Chamelaucium* alliance, it only needs to be restated that no other Myrtaceae are known to be arillate.

The reniform/arillate seed type occurs in *Balaustion*, *Hypocalymma*, *Rinzia*, *Ochrosperma*, *Triplinaria*, *Euryomyrtus* and some other small groups of species (see section immediately above) that await definition as separate genera, and is the only seed type that occurs in them. This seed type thus occurs across the three evolutionary lines of Briggs & Johnson's sketch phylogram detailed above. A reasonable hypothesis is that the genera with this seed type belong on one evolutionary line rather than on three lines. It is proposed that these genera all need to be placed on one line arising from Briggs & Johnson's putative ancestor and that relationships in the remaining genera of the *Chamelaucium* alliance need to be re-assessed.

The genera on this line are quite diverse in other characters, including three stamen types (although all have anthers opening in parallel slits), and determining just how *Euryomyrtus* relates to the other genera awaits further research. However, stamen arrangement suggests it is less closely related to *Ochrosperma* and *Triplinaria* than to the other genera. The geographical distributions of the various genera would also support this observation.

Taxonomic revision of *Euryomyrtus*

Euryomyrtus Schauer, *Linnaea* 17: 239 (1843). – *Baeckea* section *Euryomyrtus* (Schauer) Bentham, Fl. Austral. 3: 76 (1867). *Lectotype* (here selected): *Euryomyrtus diffusa* (Sieber ex DC.) Schauer [= *E. ramosissima* (A. Cunn.) Trudgen].

Subshrubs low and straggling to spreading or erect, one species prostrate, glabrous except two species with margin and less frequently surfaces of the leaf lamina scabrid; trichomes shortly subconic, hard, translucent. *Leaves* opposite, appressed to spreading, distant to overlapping, shortly petiolate (sessile or very shortly petiolate in *E. maidenii*); lamina small, entire, planar, plano-convex or concavo-convex, sometimes with a slightly recurved margin, linear to sub-orbicular (tightly involute with a recurved tip and appearing 2-channelled on the adaxial surface in *E. recurva*), acuminate to very obtuse, gland-dotted, discolorous in some species. *Flowers* 1–16 on a branchlet, solitary in leaf axils or 2 or 3(4) monads on terminal or axillary brachyblasts; peduncle terminated by a pair of sub-opposite to alternate, persistent bracteoles; anthopodium prominent except in *E. inflata*. *Bracteoles* not thickened, very concave or cymbiform, deltoid to ovate to broad ovate to cordate to reniform in outline, attachment broad; margins narrow, hyaline or petaline, entire to lacinate (often minutely); centre reddish to maroon or greenish. *Hypanthium* narrowly to broadly obconic to hemispherical to semi-ellipsoid or barrel-shaped, smooth, oil glands obvious in some species. *Calyx lobes* 5, erect to slightly spreading, short and broad, up to c. half as long as petals, not or slightly keeled, petaline in some species and usually white, hyaline (and then very narrow) in others, ragged to lacinate; centres often reddish. *Corolla* 3–15 mm diam., white or white tinged with red or various shades of pink or mauve; petals spreading or slightly reflexed, more or less orbicular, claw short or absent. *Processes* in groups of 2–15 at base of adaxial side of petal claws, white or reddish. *Stamens* 3–29, one opposite each petal except when less than 5, usually one opposite each calyx lobe except when less than 10, the remainder between the centres of the petals and calyx lobes, but two species lose those opposite the calyx lobes before those between the petals and calyx lobes. *Filaments* free, terete, slightly flattened near the base in some species, tapering towards and curved inwards at the apex, antepetalous filaments longest and these stamens equalling or just exceeding the calyx lobes in four species, equalling to markedly exceeding them in one species and markedly exceeding them in the remaining species (almost twice their length). *Anthers* dorsifixed and versatile; loculi parallel, opening in slits; connective gland sub-globular to globular or cylindrical. *Ovary* 3- or rarely 4-locular, obovoid, depressed around base of style, lower 1/3–3/4 fused to hypanthium, top equalling staminophore except in one species; placentas axile, slightly raised, elliptic to very broadly oblong, areas on the floral axis (in one species edges free, but not stalked), slit down centres; ovules reniform, 2–6 per loculus, collateral, arranged in rows or in one species arranged around the placenta. *Style* fusiform to cylindric, slender to stout, inserted deeply into the ovary, equalling the calyx lobes or the antepetalous stamens in the species where these markedly exceed the calyx lobes; stigma capitate. *Fruit* a globular or cylindric capsule, equalling the calyx lobes in most species, exceeding them in one and only equalling the staminophore in another (*E. inflata*), fused to the hemispherical to barrel-shaped hypanthium only near the base in most species, pendant in some species, definitely erect in one. *Dehiscent fruit* opening widely to very widely in most species, not widely in one (*E. inflata*), hypanthium becoming saucer-shaped when fruit open very widely. *Seeds* reniform, arillate; hilum small, in the centre of the concave side; testa crustaceous, minutely colliculate to colliculate, light to mid brown, straw-coloured in one species. *Embryo* (observed only in *E. maidenii*) filling seed, radical massive, cotyledons flattened parallel to the plane between them, c. 0.4 mm long on a slender neck, neck and cotyledons folded back onto the radicle.

Size and distribution. *Euryomyrtus* is a genus of seven species, one of which has two subspecies. It is restricted to the southern parts of the Australian mainland and to Tasmania, with five species endemic to the south-west of Western Australia (Figure 1), one species occurring in southern New South Wales and one species widespread in Victoria and Tasmania and also occurring in a small area in the eastern part of South Australia and southern New South Wales.

Inflorescence structure. The uniflorescence in *Euryomyrtus* is a monad, and at first seems homologous to the monads developed in some *Rinzia* species. However the bracteoles are not opposite as in *Rinzia* but sub-opposite to alternate (e.g. in *E. leptospermoides* they can be up to 0.5 mm apart) and do not

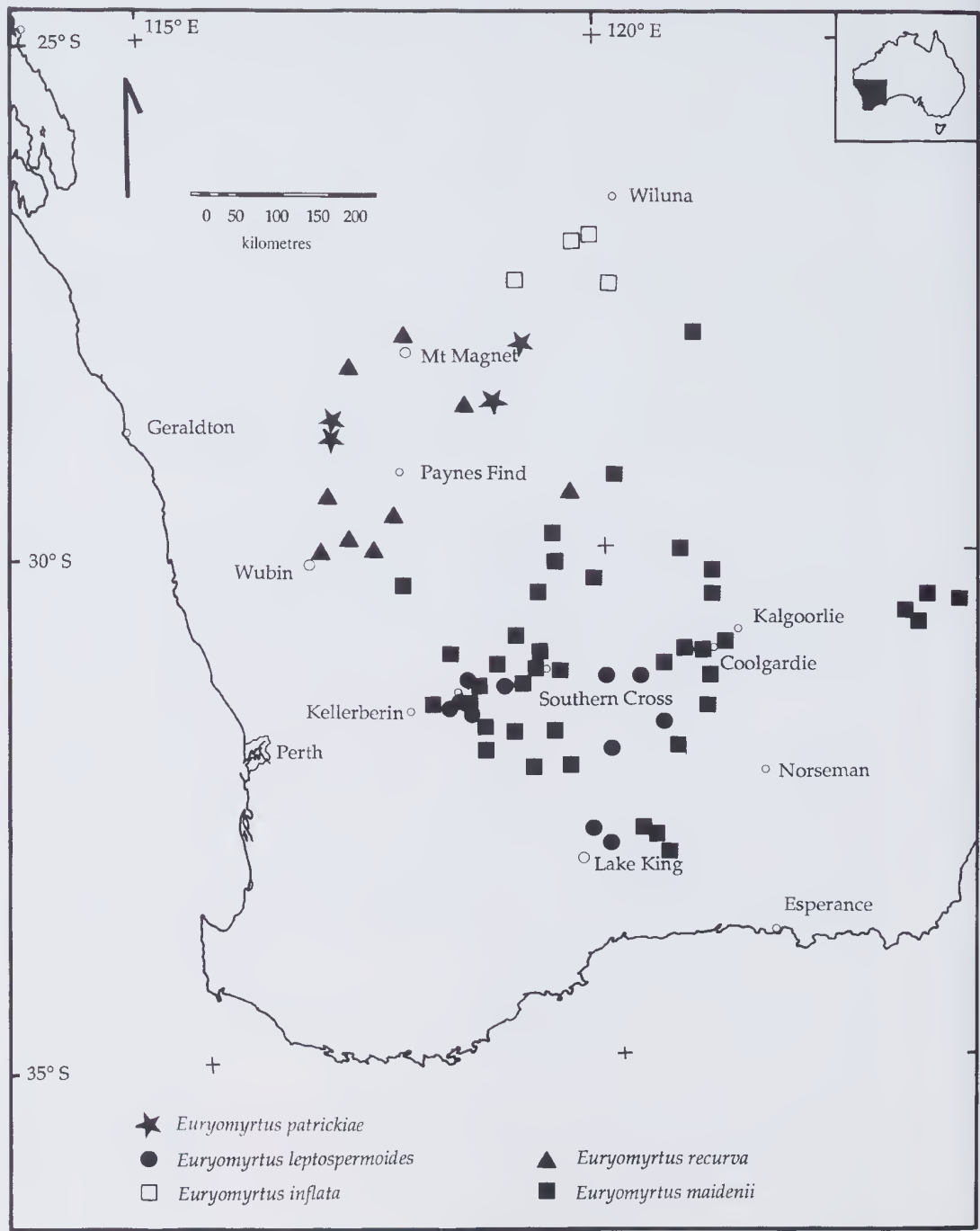


Figure 1. Distribution of the Western Australian species of *Euryomyrtus*.

subtend a distinct articulation as in that genus (there is an articulation but when the flowers fall the peduncle falls with them). Usually two or three (sometimes four) monads are grouped together on a brachyblast, however single monads in a leaf axil with no development of a brachyblast are not uncommon and two species, *E. maidenii* and *E. patrickiae*, have only axillary monads. On one specimen of *E. leptospermoides* (R.J. Cranfield 5287, PERTH) what at first appear to be axillary monads have the peduncle subtended by very small bracts; these are in fact axillary brachyblasts bearing only one monad and without the shoot axis developing. Presumably the axillary monads (i.e. a peduncle and flower only, with no axis bearing bracts subtending the peduncle) found in this and other species have been derived from further reduction of the brachyblast axis.

In the terminology of Briggs & Johnson (1979) the 2–4 monads on a brachyblast constitute a confluence and a branchlet bearing several brachyblasts a superconfluence. The brachyblasts are most frequently terminal but also occur in leaf axils along the branchlets. When they are terminal the brachyblasts are auxotelic while those that occur in leaf axils are sometimes anauxotelic.

The inflorescence described above for *Euryomyrtus* has much in common with that described by Briggs & Johnson (1979: 202) for the related genus *Hypocalymma*. However in *Hypocalymma* the brachyblasts are lateral rather than terminal and lateral and are usually anauxotelic and rarely auxotelic rather than the reverse.

The bracteoles in *Euryomyrtus* are attached very broadly to the peduncle and are very concave with the base of the upper bracteole enclosed by the base of the lower bracteole. The overall effect is quite distinctive and is found in all species, although in *E. inflata* the anthopodium is very short and as a consequence the bracteoles are pressed up against the hypanthium and are not as concave as in the other species.

Very occasionally there can be a bud developed in the axil of one of the bracteoles and on one specimen of *Euryomyrtus recurva* some “monads” have an extra bracteole developed near the base of the hypanthium or part way between the pair of bracteoles and the hypanthium. This also happens on some specimens of *E. ramosissima* which can also have an extra bracteole below and at right angles to the sub-opposite to alternate pair. These rare developments and the sub-opposite/alternate arrangement of the bracteoles indicate that the monad in *Euryomyrtus* is the result of a reduction from a more complex structure.

Infrageneric variation. The seven species referred to *Euryomyrtus* can be divided into three groups of related species, one in south-eastern Australia and two in south-western Australia. The morphological differences between these groups and the geographical separation of the eastern group suggest that *Euryomyrtus* is a genus of considerable antiquity.

The eastern group comprises the two species *E. ramosissima* and *E. denticulata*, which appear to be very closely related to each other. They have unthickened leaves which are often discolourous, can have recurved margins (rather like those of some *Rinzia* species), have translucent trichomes on the margins and also have similar flower shape. However they differ in characters such as stamen number (3–10 and 19–25 respectively), ovule number (3–5 and 2 or 3 respectively), the degree of fusion of the ovary to the hypanthium, the shape of the calyx lobes and the length of the filaments (those of *E. denticulata* are quite long so that the stamens are distinctly exserted).

Also very closely related to each other are two of the western species, *E. leptospermoides* and *E. inflata*, which form the second group. They have leaves that are little thickened but which have no

trichomes, do not have recurved margins and are concolorous. The flowers of this species pair are rather disimilar to those of the previous pair, having the hypanthium hemispherical or barrel-shaped (with a hemispheric base) rather than obconic, more rounded calyx lobes and shorter peduncles and anthopodia.

However, the three members of the remaining western group (*E. maidenii*, *E. patrickiae* and *E. recurva*) seem to be less closely related to one another, although they all consistently have ten stamens. Their leaves are quite different from those of the other two groups. *Euryomyrtus recurva* has tightly involute leaves with recurved tips, while *E. maidenii* and *E. patrickiae* have small, concave-convex, slightly thickened (ericoid) leaves. The latter two species appear to be more closely related to one another than to *E. recurva* but still show significant differences from each other, for example in the size and aggregation of their leaves.

Key to the species of *Euryomyrtus*

- 1. Stamens 10 or less
 - 2. Leaves not thickened, sometimes with recurved margins, tip never recurved, usually with short, hard, translucent trichomes (especially on margins) 6. *E. ramosissima*
 - 2. Leaves thickened, margins never recurved, abaxial surface convex, trichomes absent
 - 3. Leaves channelled on adaxial surface, tip recurved. Ovules 3–5 per loculus 3. *E. recurva*
 - 3. Leaves not channelled on adaxial surface, tip not recurved. Ovules 2 per loculus
 - 4. Processes 2–5, white, c. 0.1 mm long. Leaves sessile or with a petiole < 0.1 mm long; lamina 0.6–4 mm long 4. *E. maidenii*
 - 4. Processes 4 or 5, reddish, 0.2–0.3 mm long. Leaves with a petiole 0.2–0.4 mm long; lamina 1–5 mm long 5. *E. patrickiae*
- 1. Stamens greater than 16
 - 5. Stamens prominently exserted (twice length of calyx lobes). Ovules 2 per loculus. Plants prostrate 7. *E. denticulata*
 - 5. Stamens not prominently exserted. Ovules 3–6 per loculus. Plants spreading to erect
 - 6. Stamens 16–23. Anthopodium 1.0–2.3 mm long 1. *E. leptospermoides*
 - 6. Stamens 25–29. Anthopodium less than 0.1 mm long 2. *E. inflata*

1. *Euryomyrtus leptospermoides* (C.A. Gardner) Trudgen, *comb. nov.*

Baeckea leptospermoides C.A. Gardner, *J. Roy. Soc. Western Australia* 27: 188 (1942), non *E. leptospermoides* F. Muell. ex Miq., *Ned. Kruidk. Arch.* 4: 149 (1856), *nom. nud.* Type: “Hab. in distr. Coolgardie prope Karalee, in fruticetis arenoso-glareosis, flor. m. Sept. Gardner” near Karalee, [Western Australia], 19 September, C.A. Gardner s.n. (*holo*: PERTH 01605593; *iso*: PERTH 01605607, 01605615, 01605623).

Open to compact, erect or sometimes spreading woody *shrub* usually with short branchlets from the main stems, 20–90 cm tall. *Leaves* half overlapping to densely packed and spreading or distant to just overlapping and appressed on rapidly growing stems; petiole 0.3–0.9 mm long; lamina oblong-elliptic, less commonly oblong to broadly oblong or oblong to narrowly obovate, not to slightly thickened, planar, plano-convex or shallowly concavo-convex, 1.5–4.5 mm long, 1.0–1.7 mm wide, obtuse, no distinct veins, oil glands below surface. *Flowers* 1–7 per branchlet on 1- or 2-noded brachyblasts; brachyblasts terminal and in the upper leaf axils; each peduncle subtended by a very reduced leaf c. 0.3 mm long or sometimes by a normal leaf; anthopodium 1.0–2.3 mm long; peduncle 0.8–2.5 mm long, terminated by a pair of sub-opposite to alternate bracteoles; bracteoles reniform to deltoid, concave, attachment broad, 1.0–1.4 mm long 1.3–1.8 mm wide, not thickened. *Hypanthium* hemispherical to semi-ellipsoid, 2.0–3.0 mm long, 3.4–5.0 mm diam., smooth, oil glands not obvious; calyx lobes erect to slightly spreading, transverse semi-elliptic to semi-circular to semi-elliptic or deltoid, 1.3–2.0 mm long, 1.3–1.8 mm wide, not keeled, minutely laciniate. *Corolla* 8.0–15.0 mm diam., white; petals spreading, sub-orbicular to orbicular or rarely very broadly ovate, claw very short. *Processes* 6–10, at base of adaxial side of petals, 0.4–0.6 mm long, reddish. *Stamens* 16–23, typically 20, then one opposite each petal, one opposite each calyx lobe and one between these, when more than 20 there are 2 opposite some calyx lobes, when less than 20 some calyx lobes have none opposite them and one or more intermediates missing. *Filaments* terete or very slightly flattened near the base, tapering towards apex, curved inwards at apex, antepetalous longest, equalling or just exceeding calyx lobes, 1.4–1.8 mm long, antesepalous shortest, 0.9–1.2 mm long. *Anthers* 0.5–0.6 mm long; connective gland obovoid, 0.2–0.3 mm diam. *Ovary* 3-locular, lower two-thirds fused to hypanthium, top equalling staminophore; placentas slightly raised elliptic areas on the floral axis, c. 0.4 mm long; ovules 3–5 per loculus. *Style* stout, fusiform, inserted into top of ovary, equalling antepetalous anthers. *Undehisced fruit*: hypanthium hemispheric, capsule not quite equalling calyx lobes. *Dehisced fruit*: capsule opening widely. *Seeds* very stoutly reniform, c. 1.7–1.8 mm long; aril very small (possibly absent in some specimens); testa minutely colliculate, straw-coloured, dull. (Figure 2A–C)

Selected specimens examined. WESTERN AUSTRALIA: Koorarawalyee, 40 miles [64 km] E of Southern Cross, J.S. Beard 3878 (PERTH); 12 miles [19 km] ENE of Merredin on Great Eastern Highway, B.G. Briggs 232, (NSW); 16.7 km from Moorine Rock towards Perth along Great Eastern Highway, E.M. Canning WA 68/2680 (CBG); 4 km S of Korbel, 32°42'S, 118°09'E, R.J. Cranfield 5287 (PERTH); along State vermin fence no. 7, 105 km SE of Southern Cross, 80 km S of Great Eastern Highway, 31°51'S, 120°01'E, J. Dodd 405 (PERTH); Merredin, M. Koch 2737 (MEL); Muntagin, E.T. Bailey 477 (PERTH); Karalee, J.W. Green 1699 (PERTH); Boodarding Rock, c. 37 km SE of Marvel Loch, K.R. Newbey 6045 (PERTH).

Distribution. Endemic to Western Australia, known only from Merredin to Koorarawalyee (east of Southern Cross) in a belt paralleling Great Eastern Highway. Most specimens are from along Great Eastern Highway but some are from south of the Highway. (Figure 1)

Habitat. *Euryomyrtus leptospermoides* grows in low vegetation including heaths, shrublands and thickets, sometimes with *Allocasuarina* or mallee *Eucalyptus* species on a variety of soils including yellow sand, yellow clayey sand and sandy clay.

Flowering period. Flowering recorded from August to November but mostly September and October.

Conservation status. CALM Conservation Code: Priority Three. This species is not widely distributed and is apparently uncommon, with three of the six specimens collected since 1980 coming from the same locality. However, it is probably not threatened as in the eastern part of its range clearing for

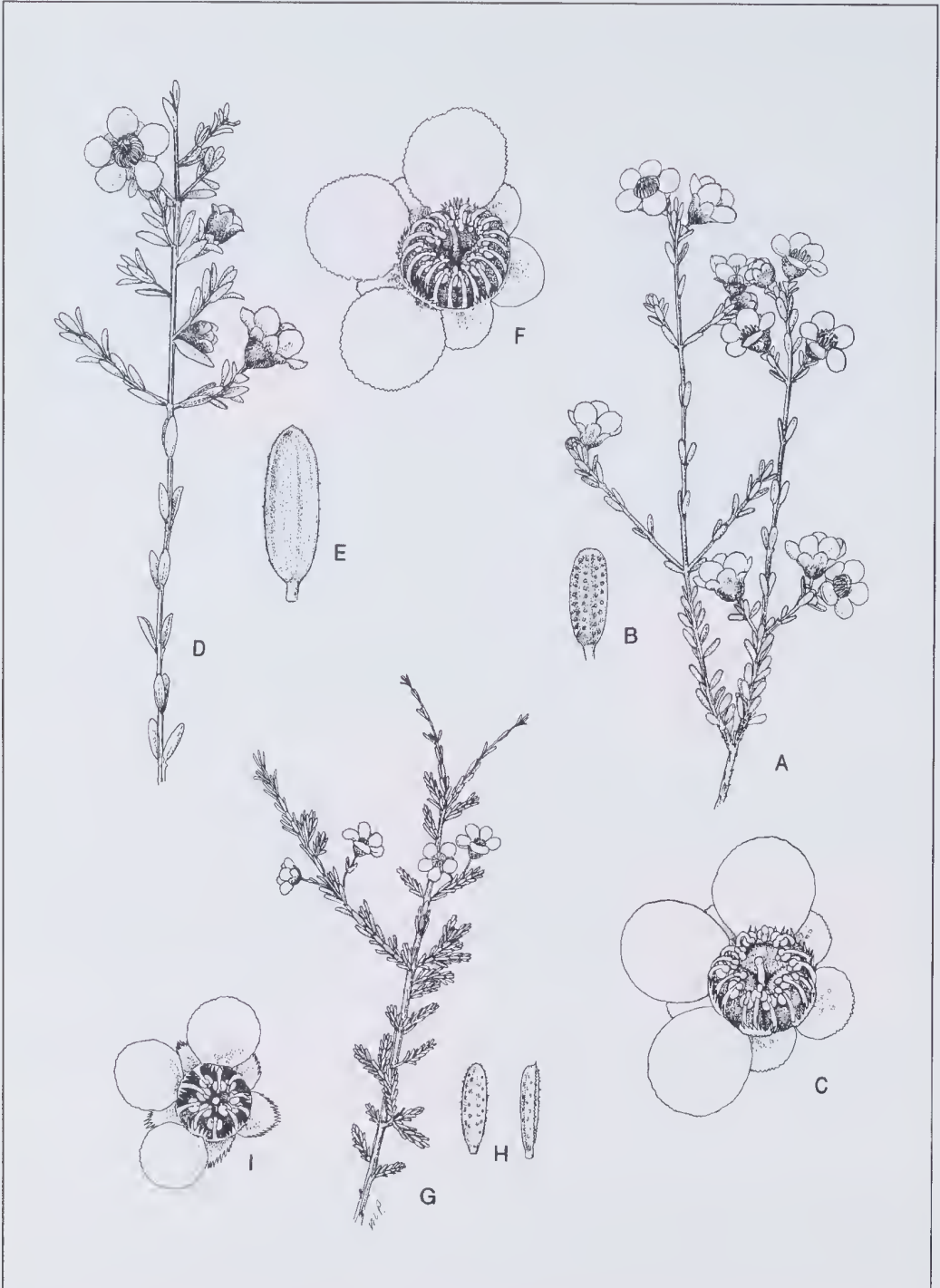


Figure 2. A-C. *Euryomyrtus leptospermoides*. A - flowering branch (x1), B - leaf (x4), C - flower with two petals removed (x4); D-F. *Euryomyrtus inflata*. D - flowering branch (x1), E - leaf (x4), F - flower with two petals removed (x4); G-I. *Euryomyrtus patrickiae*. G - flowering branch (x1), H - two views of leaf (x5), I - flower with two petals removed (x5). Drawn from K.R. Newbey 9659 (A-C), M. Hislop 437(D-F) and E. Bennett & P. Ellery GG029 (G-I).

agriculture is not extensive. One of the specimens seen is from Jilbadji Nature Reserve (Boodarding Rock). Surveying of the species to determine its exact status is desirable.

Notes. The seeds seen were not fully mature as the embryos were not fully developed. However the testa seemed to be reasonably mature (it is quite thick and has a columnar structure).

The staminophore is sinusoidal and this accentuates the difference in length of the antepetalous and antesealous filaments as the latter occur in the troughs and the former on the crests.

The monads occur on 1- or 2-noded brachyblasts (short-shoots) with one to three monads present, each subtended by a reduced leaf (c. 0.3 mm long and not at all leaf-like) and there is a dormant shoot apex present. The brachyblasts usually occur at the end of branchlets (ie. terminally) but occasionally occur in the axils of the second pair of leaves from the branchlet apex. On some specimens the flowers are subtended by properly developed leaves rather than reduced ones.

No fully dehiscent fruits were seen, but from the most mature fruits seen it appears likely that they would open quite widely. It is not clear from the material available whether or not the fruits are pendulous or held erect when dehiscing.

2. *Euryomyrtus inflata* Trudgen, *sp. nov.*

Fruticulus effusus 30–70 cm altus. Folia appressa vel leviter effusa, oblonga vel late elliptica, ovata, vel obovata, obtusa, 1.9–6.5 mm longa; petioli 0.3–0.6 mm longi. Flores 1 vel 2 per ramulos in brachyblastis 1-nodis terminalibus vel axillaribus orti; anthopodium < 0.1 mm longum; pedunculus c. 0.7 longus, per bracteolas duas subopposita terminatus. Hypanthium doliiforme 4.5–4.7 mm diam.; calycis lobi erecti vel leviter effusi. Corolla alba, 7.5–10.0 mm diam.; petala effusa vel leviter reflexa. Processi 10–12 ad basim petalorum lateris adaxialis affixi, c. 0.3 mm longi, albi. Stamina 25–29, uno in quoque petalo opposito ceterum bini ternique aggregati inter petala atque calycis lobos et calycis lobos oppositos; filamenta teretia, angustata, incurva; filamenta antepetala calycis lobis leviter excedentia; antherae dorsifixae, versatiles. Ovarium 3- vel 4-loculare. Stylus gracilis fusiformis. Placenta convexa elliptica in axe florali affixa; ovula 3–6 per loculum. Fructus ante dehiscendum: hypanthium sursum expansum, doliiforme, sub calycis lobis contractum, induratum (nec lignosum), pallido brunneum; capsula staminophorum aequans. Fructus post dehiscendum erectus, capsula haud late aperiens. Semina reniformia, c. 1.7–1.8 mm longa; arillus parvus; testa colliculata, straminea vel pallido brunnea.

Typus: 4.7 km along road to Wiluna from the Meekatharra to Leonora road, Western Australia, 1 June 1982, M.E. Trudgen 2943 & M.I. Blackwell (*holo:* PERTH 01637096; *iso:* AD, CANB, K, MEL, NSW, PERTH 01637118).

Spreading woody *shrub* with numerous stems from the ground and short branchlets from them, 30–70 cm tall. *Leaves* distant, half overlapping, appressed to slightly spreading; petiole 0.3–0.6 mm long; lamina straight or slightly recurved, oblong to broadly elliptic to ovate or obovate, not to slightly thickened, planar or shallowly concavo-convex, 1.9–6.5 mm long, 1.6–2.2 mm wide, obtuse, veins visible on abaxial surface when leaves not thickened, dull green or grey-green on different individuals in the same population. *Flowers* 1 or 2 per branchlet on a 1-noded terminal brachyblast, or rarely the brachyblasts are in the upper leaf axils, each peduncle subtended by a very reduced leaf c. 0.3 mm long; anthopodium < 0.1 mm long; peduncle c. 0.7 mm long, terminated by a pair of sub-opposite bracteoles which clasp the base of the hypanthium; bracteoles very broadly cordate, very concave, attachment

broad, 1.2–1.5 mm long 2.0–2.2 mm wide, thin. *Hypanthium* barrel-shaped, 4.0–4.5 mm long, 4.5–4.7 mm diam., the base hemispheric, smooth, oil glands not obvious; calyx lobes erect to slightly spreading, transversely semi-elliptic to semi-circular 1.0–1.5 mm long, 2.5–3.0 mm wide, slightly keeled, minutely lacinate. *Corolla* 7.5–10 mm diam., white; petals spreading to slightly reflexed, broadly ovate, broadly oblong-elliptic, oblong or sub-orbicular, 3.5–3.7 mm long, 3.0–3.5 mm wide, claw very short or absent. *Processes* 10–12, at base of adaxial side of petals, c. 0.3 mm long, white. *Stamens* 25–29, one opposite each petal, the others in groups of two or three between the petals and the centres of the calyx lobes the remainder opposite the centres of the calyx lobes with one or more missing (0–4 antesealous stamens present). *Filaments* terete or very slightly flattened near the base, tapering towards and curved inwards at apex, antepetalous longest, just exceeding calyx lobes, 1.5–1.7 mm long, antesealous shortest, 0.7–0.8 mm long. *Anthers* 0.5–0.7 mm long, c. 0.5 mm wide; connective gland cylindrical, c. 0.2 mm long, c. 0.1 mm diam. *Ovary* 3- or 4-locular, half length of hypanthium, lower 3/4 fused to hypanthium; placentas slightly raised elliptic areas on the floral axis, c. 0.3 mm long; ovules 3–6 per loculus (usually 6), tending towards circular in arrangement (rather than in rows). *Style* slender, fusiform, inserted into top of ovary, equalling calyx lobes. *Undehisced fruit*: hypanthium expanded outwards, barrel-shaped, contracted under calyx-lobes, indurated but not woody, tan-coloured; capsule equalling staminophore. *Dehisced fruit*: erect, capsule not opening very widely. *Seeds* reniform, c. 1.7–1.8 mm long; arill small; testa colliculate, straw-coloured to light brown. (Figure 2D–F)

Specimens examined. WESTERN AUSTRALIA: 32 miles [52 km] S of Wiluna on road to Sandstone, A.S. George 5628 (PERTH, MEL); 70 miles [113 km] N of Sandstone on road to Wiluna, A.S. George 5654 (AD, PERTH); 4.7 km along road to Wiluna from the Meekatharra to Leonora road (type locality), M.E. Trudgen 2944 (PERTH).

Distribution. Known only from three localities on the Sandstone to Wiluna road, north of the intersection with the Meekatharra to Leonora road, Western Australia. (Figure 1)

Habitat. At the type locality *E. inflata* grows in a *Triodia/aluta maisonneuvii* hummock grassland/low open shrubland with scattered emergent *Acacia* and *Hakea* on deep red sand. Similar vegetation and soil data are given with other collections.

Flowering period. Flowering collections have only been made in June and July, but this probably reflects the paucity of collections made for this species.

Conservation status. CALM Conservation Code: Priority One. *E. inflata* must be considered as needing investigation as it is only known from four collections (two of which are from the same locality) and may be a quite uncommon species. However, it occurs in an area that is not very well collected.

Etymology. The specific epithet refers to the inflated hypanthium in the fruit.

Notes. The leaves and the size and general appearance of the flowers of *Euryomyrtus inflata* indicate that it is quite closely related to *Euryomyrtus leptospermoides*, certainly closer than any other species is to either. It seems probable that they are the result of divergence between two isolated populations of a common ancestor and that this separation is relatively recent. The most striking difference between the two is the expansion of the hypanthium in the fruit of *Euryomyrtus leptospermoides*, with other morphological differences being essentially of a quantitative rather than a qualitative nature. This expansion of the hypanthium is unique in the genus and gives the fruit a quite different appearance to that of the other species, particularly as the staminophore does not expand so that the fruit is

it occupies a quite different ecological niche occurring on red sand plains with *Triodia*, rather than in heathlands or shrublands. It is also unusual in that the fruit is held erect when dehiscing rather than becoming pendent.

The branchlets give the impression that the leaves on each are all from one seasonal growth unit. If this is so then simply dropping its leaves during summer may be a strategy for coping with the long summer drought that occurs in the area where *E. inflata* grows.

3. *Euryomyrtus recurva* Trudgen, *sp. nov.*

Fruticulus ad 70 cm altus; caules graciles ramulis brevibus gerentibus. Folia appressa vel effusa, linearia, arcte involuta (pagina adaxiali ut videtur canaliculata), incrassata, infra convexa (semi-circularia), 1.7–4.0 mm longa, apice recurvo acuto; petioli 0.1–0.2 mm longi. Flores 1–3 per ramulus in brachyblastis axillaribus vel terminalibus orti; anthopodium 1.0–1.7 mm longum; pedunculus 0.6–1.5 mm longus per bracteolas duas suboppositas terminatus. Hypanthium obconicum c. 2.0 mm diam.; calycis lobi erecti vel leviter effusi. Corolla rosea 4.5–6.5 mm diam; petala effusa. Processi 2–4 ad basim petalorum lateris adaxialis affixi, c. 0.3 mm longi, albi. Stamina 10 petalis et calycis lobis opposita; filamenta teretia angustata incurva; filamenta antepetala calycis lobis aequans vel leviter excedentia; antherae dorsifixae, versatiles. Ovarium 3-loculare. Stylus cylindricus. Placenta convexa elliptica in axe florali affixa; ovula 3–5 per loculum. Fructus antedehiscentem: hypanthium hemisphaericum; capsula calycis lobis aequans vel leviter excedens. Fructus post dehiscentem: capsula late aperiens. Semina reniformia, c. 2.2 mm longa; arillus bene evolutus; testa colliculata, pallido brunnea, nitida.

Typus: 5 miles [8 km] north-east of Wubin on Great Northern Highway, Western Australia, A.S. George 5675 (*holo*: PERTH 01637126; *iso*: AD, CANB, MEL, NSW).

Shrub to 70 cm tall, with slender woody stems bearing short leafy branchlets. *Leaves* to 2/3 overlapping and spreading or distant and appressed on rapidly growing stems; petiole 0.1–0.2 mm long; lamina linear, tightly involute (appearing 2-channelled on adaxial surface), thickened, convex (semi-circular) below 1.7–4.0 mm long, 0.4–0.6 mm wide, smooth, oil glands visible below surface, tip recurved, pointed. *Flowers* usually 1–3 (rarely to 11) per branchlet, inflorescences axillary (usually in the axils of the upper leaves) or terminal brachyblasts of 1 or 2(4) flowers; each peduncle subtended by a very reduced bract-like leaf c. 0.3 mm long or sometimes by a more normal leaf c. 1.0 mm long; anthopodium 1.0–1.23 mm long; peduncle 0.6–2.5 mm long, terminated by a pair of sub-opposite bracteoles; bracteoles very broadly cymbiform, 0.6–0.9 mm long c. 0.9 mm wide, not thickened, attachment broad, margins white, minutely laciniate. *Hypanthium* obconic, c. 1.3 mm long, c. 2.0 mm diam., smooth, oil glands not obvious; calyx lobes erect to slightly spreading, semi-circular to semi-elliptic or deltoid, 0.9–1.3 mm long, 1.0–1.4 mm wide, very slightly keeled, margin white, ragged to laciniate. *Corolla* 4.5–6.5 mm diam., pink; petals spreading, sub-orbicular to transversely elliptic or squarish, claw very short. *Processes* 2–4, at base of adaxial side of petals, c. 0.3 mm long, white. *Stamens* 10, one opposite each petal and each calyx lobe. *Filaments* terete, tapering towards apex, curved inwards at apex, antepetalous longest, equalling or just exceeding calyx lobes, 0.8–1.0 mm long, anteseptalous 0.6–0.8 mm long. *Anthers* c. 0.5 mm long; connective gland globular, 0.1–2 mm diam. *Ovary* 3-locular, lower half fused to hypanthium, top almost equalling staminophore; placentas slightly raised elliptic areas on the floral axis, c. 0.2 mm long; ovules 3–5 per loculus, collateral. *Style* cylindrical, inserted into top of ovary, equalling or just exceeding antepetalous anthers. *Undehiscent fruit*: hypanthium hemispherical, capsule equalling or just exceeding the calyx lobes, which form a persistent rim on the hypanthium. *Dehiscent fruit*: capsule opening very widely. *Seeds* reniform, c. 2.2 mm long; aril well developed; testa colliculate, light brown, shiny. (Figure 3A–E)

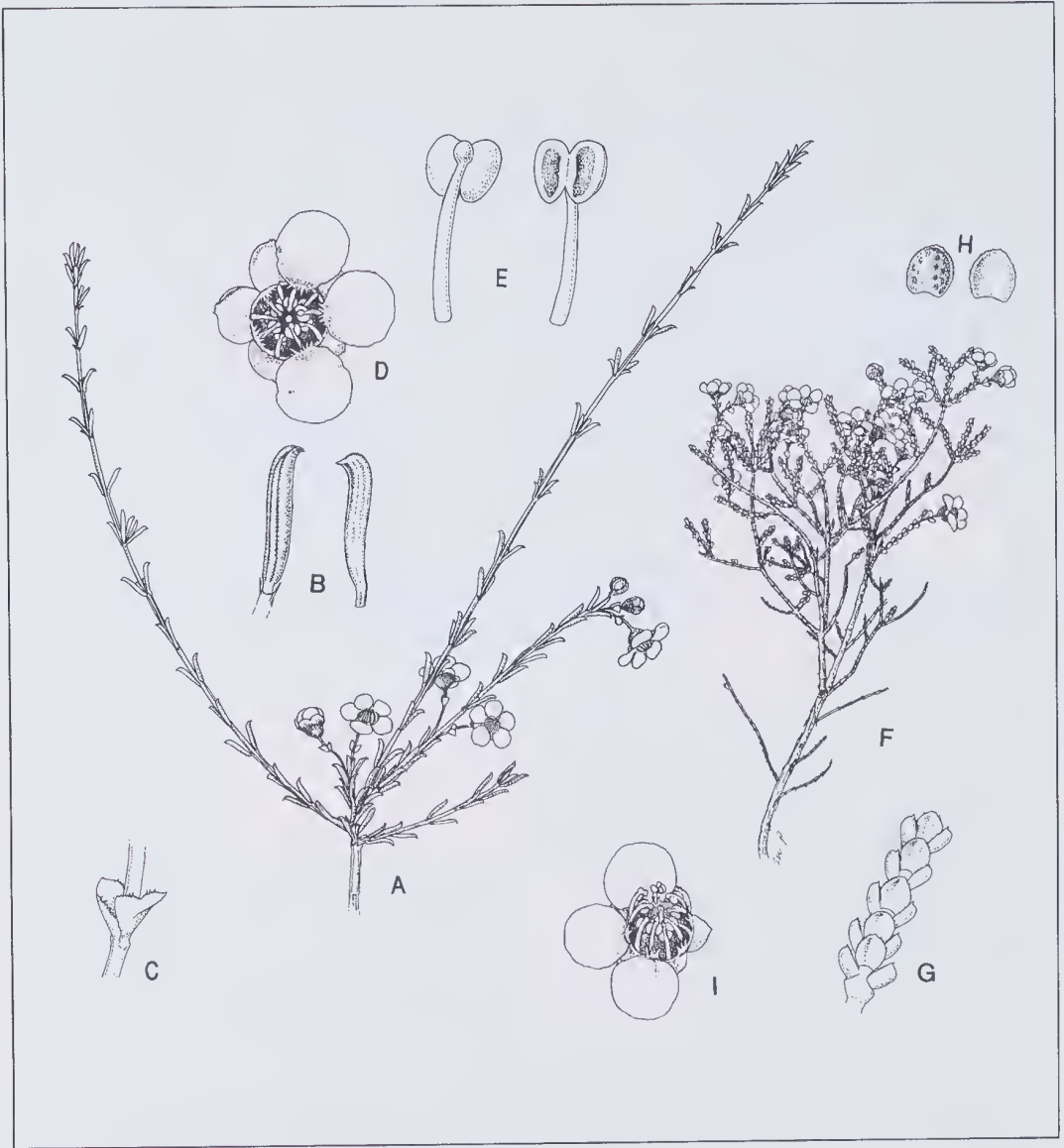


Figure 3. A-E. *Euryomyrtus recurva*. A - flowering branch (x1), B - two views of leaf (x5), C - bracteoles (x10), D - flower with two petals removed (x5), E - two views of stamen (x20); F-I. *Euryomyrtus maidenii*. F - flowering branch (x1), G - branchlet (x8), H - two views of leaf (x8), I - flower with two petals removed (x4).

Specimens examined. WESTERN AUSTRALIA: W of Youanmi, T.E.H. Aplin 6102 (AD, PERTH); Wanarra, near Lake Monger, C.A. Gardner 12499 (PERTH, KEW); Wanmarie Station (formerly Wandary Station) next to Merroe Siding, A.L. Payne 1038 (MEL, PERTH); Lake Moore, A. Robinson 31, 54, 129 and 143 (PERTH).

Distribution. Known only from between Wubin, Youanmi and Lake Austin, Western Australia. (Figure 1)

Habitat. The type was found in *Acacia* tall shrubland on red loam and the A.L. Payne 1038 specimen was found in red sand over laterite (Kali land system).

Flowering period. Flowering recorded from June to September.

Conservation status. CALM Conservation Code: Priority Three. *E. recurva* must be considered as needing investigation as it is only known from five localities from a fairly restricted area. Searches (by myself) of a restricted nature in two of the localities known, and surrounding areas, have failed to relocate the species. However it is probably not threatened as it occurs in a poorly collected region where there has not been widespread clearing for agriculture.

Etymology. The specific epithet refers to the recurved tips of the leaves, which are unique in the genus.

Notes. While the testa is definitely crustaceous it is fairly thin and does not have the thick, columnar structure of the testa of *E. leptospermoides* seeds. In the fruit observed only one of the two ovules in a loculus developed.

The inflorescences are interpreted as brachyblasts as in both the terminal and axillary situation the peduncles are subtended by bracts that are positioned at right angles to the upper leaf pair in the terminal situation and the subtending leaf in the axillary situation. Occasionally, the shoot apex between the peduncles grows on while flowering is in progress giving the appearance of axillary monads, but closer inspection shows that the peduncles are subtended by bracts positioned at right angles to the closest leaves. Rarely, an extra bracteole is developed under the hypanthium, whether this is simply an aberration or indicates a reduction from a metaxymonad to a monad in the more general situation described above is unclear; on the specimen where this was observed the anthopodium was 0.4 mm long and the intermediate axis 1.3 mm long.

The species is only known from eight specimens so it is likely that the measurements recorded for different structures in the description above will be exceeded when more specimens are collected.

4. *Euryomyrtus maidenii* (Ewart & Jean White) Trudgen, *comb. nov.*

Baeckea maidenii Ewart & Jean White, *J. Roy. Soc. New South Wales* 45: 184 (1909). *Type:* Cowcowing, Western Australia, M. Koch 1021 (*holo:* NSW; *iso:* MEL).

Open to dense, woody *shrub* with numerous, densely leaved, small branchlets, spreading or erect, 10–60 cm tall. *Leaves* quadrifarious, 1/4–2/3 overlapping and slightly spreading, or distant to just overlapping and appressed on quick growing shoots; petiole absent (lamina attachment broad) or < 0.1 mm long; lamina very variable in shape, narrowly to broadly elliptic, oblong, linear or sub-orbicular, plano-convex or concavo-convex, not much thickened to (usually when concavo-convex) semi-terete or thicker (when plano-convex), 0.6–3.9 mm long, 0.2–1.1 mm wide, acute to very obtuse, abaxial surface very smooth, or with three longitudinal, slightly raised veins and the tip keeled, or rarely with raised oil glands. *Flowers* 1–5 on a branchlet, solitary in the upper leaf axils, often with 1 or 2 in axils of last pair of leaves; anthopodium 0.7–1.7 mm long; peduncle 0.5–1.1 mm long, terminated by a pair of bracteoles; bracteoles ovate to broadly ovate or deltoid, acute to acuminate, concave, not thickened, 0.8–1.5 mm long, bases overlapping. *Hypanthium* semi-ellipsoid to obconic, 1.0–1.6 mm long, 1.6–2.1 mm diam., smooth, top reddish, bottom green; calyx lobes erect, transversely semi-elliptic, semi-elliptic or deltoid, thin, not keeled, 0.8–1.0 mm long, margins very thin, white, shortly lacerated, centre brown-maroon. *Corolla* 4.0–7.5 mm diam., white, mauve or various shades of pink;

petals spreading, sub-orbicular to broadly ovate, shortly clawed, 2–3 mm long. *Stamens* 10, one opposite each calyx lobe and petal, antepetalous longer, not quite equalling to markedly exceeding calyx lobes. *Filaments* terete, tapering from the base, tip incurved, antepetalous 0.9–1.7 mm long. *Anthers* 0.3–0.4 mm long; connective gland sub-globular or slightly curved, c. 0.1 mm diam. *Processes* 2–5, between petals and antepetalous filaments, c. 0.1 mm long, white. *Ovary* 3-locular, top equalling staminophore, lower half fused to hypanthium; placentas raised broadly oblong areas on floral axis, c. 0.3 mm long by 0.2 mm wide; ovules 2 per loculus, collateral, 0.5 mm long. *Style* slender, fusiform, inserted deeply into ovary, equalling calyx lobes, or where stamens markedly exceeding calyx lobes slightly exceeding stamens. *Undehisced fruit*: hypanthium thin, hemispheric, upper part of ovary expanded to equal or slightly exceed calyx lobes. *Dehisced fruit*: capsule opening widely, valves obtuse, hypanthium becoming saucer-shaped. *Seeds* reniform, 1.7–1.8 mm long; aril present; testa thin, light brown, shiny, colliculate. (Figure 3F–I)

Selected specimens examined. WESTERN AUSTRALIA: W of Bullabulling, which is c. 65 km SW of Kalgoorlie, A.M. Ashbey 2509 (B, L, LE, NCU, PERTH, SA, UC, W); 10.4 miles [16.7 km] from Moorine Rock towards Perth along Great Eastern Highway, 10 Sep. 1968, E.M. Canning (CBG); base of water tank, 12 km E of Ghooli, R.J. Cranfield 1513 (AD, NSW, PERTH); 26 km due S of Bodallin, R.J. Cranfield 2306 (PERTH); Younegin, 1892, Miss Alice Eaton (MEL); 287 mile post on Paynes Find to Mount Magnet road (Great Northern Highway), A.R. Fairall 1802 (KINGS PARK, PERTH); Bronti, C.A. Gardner 12187 (BRI, K, PERTH); 20 miles [32.2 km] E of Cundeelee, 9 Mar. 1963, M.C. George, (PERTH); Coolgardie, July 1899, R. Helms (PERTH); Yilgarn, near Mt Moore, 1889, H.S. King & De Courcy Lefroy (MEL); 13 km S of Mt Glass, Bremer Range, K. Newbey 5391 (MEL, PERTH); 6 miles [10 km] W of Broad Arrow, B.L. Powell 74018 (PERTH); 3 miles [4.8 km] W of Crampthorne, S of Muntadgin, R.D. Royce 7877 (CBG, PERTH); 6.5 km N of Hickey Ricken Soak (N of Bullfinch), R.A. Saffrey 954 (CANB, MEL, PERTH); northern boundary gate of Lake Barlee Station with Youanmerry & Youangarra Stations, R.A. Saffrey 1004 (PERTH); between Salmon Gums and Lake King, 39.2 km W of the turnoff to Peak Charles, M.E. Trudgen 1712 (AD, CBG, K, MEL, NSW, PERTH).

Distribution. The species is restricted to the south-west of Western Australia with most collection records from a belt parallelling Great Eastern Highway from Cunderdin in the west to near Cundeelee in the east. However, the species extends north to the Paynes Find–Lake Barlee area and south to the Bremer Range area (east of Lake King). (Figure 1)

Habitat. Over its range *E. maidenii* is found in a variety of vegetation types on a variety of soils. In the north of its range it grows with *Triodia* (Spinifex) on red and yellow sands. In the centre of its range it grows in a range of heath, shrubland and scrub types (including some with mallee *Eucalyptus* species), mostly on yellow sands. In the southern part of its range it grows in heaths and open *Eucalyptus* woodlands on white sands, clayey white sands and lateritic soils.

Flowering period. Flowering has been recorded from March to October, with a peak in August/September and only one record each for March and April.

Chromosome number. $n = 11$ (Rye 1979).

Conservation status. This is the most widespread of the Western Australian species referred to *Euryomyrtus* and although many populations in the wheatbelt part of its distribution must have been lost through clearing for agriculture it appears to be fairly secure.

Notes. The flowers in the axils of two opposite leaves may be at quite different stages, for example one may be at anthesis while the other is in fruit.

This widespread species is quite variable and close study may show that some of this variation is worthy of subspecific recognition.

5. *Euryomyrtus patrickiae* Trudgen, *sp. nov.*

Euryomyrto maidenii affinis sed foliis petiolaris et processibus longioribus rubellis ad basim petalorum affixis differt.

Typus: Great Northern Highway, 41.7 km north of Paynes Find, Western Australia, 16 July 1996, S. Patrick 2679 (*holo:* PERTH 05512689; *iso:* CANB, MEL).

Open, spreading, divaricately branched woody *shrub* with short branchlets from the stems, to 1 m tall and 1 m across. *Leaves* distant and appressed on some older or quickly elongating branchlets to densely packed and slightly spreading on shorter, younger branchlets; petiole 0.2–0.4 mm long, subtended at each side by a very small, hair-like stipule; lamina narrowly obovate, sometimes elliptic or rarely ovate on atypically short leaves, slightly to moderately thickened, the adaxial surface flat to shallowly concave, the abaxial surface shallowly convex to almost semicircular but the sides then somewhat flattened, 1–5 mm long, 0.4–1 mm wide, obtuse, the adaxial surface with no veins or oil glands, the abaxial surface with oil glands in 4 irregular rows separated by the midrib and two veins parallel to it, these 3 veins indistinct to slightly raised, the midrib generally more distinct than the others and sometimes fairly prominent, becoming keel-like at the apex and rarely having a small point; the margins with short, irregular outgrowths of the cuticle. *Flowers* 1–4(9) on a branchlet; inflorescences of solitary monads in axils of normal leaves, either near the middle of the short lateral branchlets or near the base of the elongate branchlets (sometimes also with a pair (or more) near the top of the elongated shoots); anthopodium 1.3–2.8 mm long; peduncle 0.3–1.6 mm long, terminated by a pair of sub-opposite bracteoles, rarely also a single bracteole part way up the anthopodium at right angles to the pair terminating the peduncle; bracteoles semi-elliptic, auriculate, with a broad attachment, concave (especially on dried material), 1.0–1.5 mm long, 1.0–1.1 mm wide, not thickened, midrib prominent on abaxial side, almost entire to irregularly shortly lacerated. *Hypanthium* obconic to hemispherical, 1–1.4 mm long, 2.4–2.8 mm diam., smooth, oil glands not obvious; calyx lobes erect or slightly spreading, broadly deltoid to (less often) transversely semi-elliptic or semi-elliptic, 0.9–1.5 mm long, 1.4–1.6 mm wide, centre herbaceous (green or sometimes reddish) with a narrow to broad white, petaline border, margin entire to laciniate. *Corolla* light pink, c. 6.5 mm diam.; petals spreading, sub-orbicular to very broadly ovate, claw short. *Processes* 4 or 5, at base of adaxial side of petals, 0.2–0.3 mm long, reddish. *Stamens* 10, one opposite each petal and calyx lobe. *Filaments* terete or very slightly flattened near the base, tapering towards and curved inwards the apex, antepetalous longest, exceeding calyx lobes and style, 0.8–1.0 mm long, antesepalous shortest, 0.4–0.6 mm long. *Anthers* 0.3–0.4 mm long; connective gland cylindrical, 0.2–0.3 mm long. *Ovary* 3-locular, sides and base fused to the hypanthium, top slightly convex, not equalling staminophore; placentas raised elliptic areas c. 0.2 mm long on the floral axis, deeply divided along the centre; ovules 2 per loculus, collateral c. 0.4 mm long. *Style* cylindrical, inserted into top of ovary, exceeding calyx lobes, not quite equalling antepetalous anthers. *Undehisced fruit:* hypanthium hemispherical, capsule expanded at top to equal calyx lobes. *Immature seeds* reniform, c. 1.5 mm long; aril well developed; testa minutely colliculate.

Selected specimens examined. WESTERN AUSTRALIA: Burnerbinmah Station, NW of Paynes Find, Nangel Paddock, 500 m N of Wadda Wadda Well, 29 Mar. 1997, S. Patrick *s.n.* (PERTH); Burnerbinmah Station, NW of Paynes Find, Nangel Paddock, 500 m N of Wadda Wadda Well, 29 Mar. 1997, S. Patrick *et al.* 106 (PERTH); Burnerbinmah Station, NW of Paynes Find, E boundary of Nangel Paddock, 20.2 km W of homestead, 29 Mar. 1997, S. Patrick *et al.* 104 (PERTH); 14.7 km E of Windsor Station

Homestead and 30.9 km W of turnoff to Paynes Find at Sandstone, 14 Sep. 1996, *S. Patrick* 2807A (PERTH); Youanmi Downs, 22 Sep. 1993, *H. Pringle* 3941 (PERTH); Gossan Hill, S of Yalgoo, 10 July 1999, *J.M. Ward s.n.* (PERTH).

Distribution. Endemic to Western Australia, known from south of Yalgoo to west of Sandstone in the Austin Botanical District. (Figure 1x)

Habitat. *Euryomyrtus patrickiae* has been collected from a plain with red sandy soil and open scrub of *Acacia* over "spinifex" and low sedges and from the slopes of a hill with brown loamy, rocky soil with *Acacia aneura* var. *aneura* low open woodland over shrubs including *Dodonaea petiolaris*, *Mirbelia* aff. *depressa* and *Erisotemon sericeus*.

Flowering period. Flowering collections have been made in March, July, September and October.

Conservation status. CALM Conservation Code: Priority Three. This species is only known from a relatively small area and several of the specimens come from one small part of Burnerbinmah Station. However, Burnerbinmah Station is owned by the Department of Conservation and Land Management and is managed for conservation and research purposes (*S. Patrick* pers comm.). Therefore, *Euryomyrtus patrickii* is probably not threatened, but further survey work is needed to confirm its conservation status.

Etymology. The specific epithet acknowledges the work of Sue Patrick (Western Australian Herbarium), who collected the type and several of the other specimens of *Euryomyrtus patrickiae* in the process extending the known range of the species. Sue has also made many other collections of small-flowered Myrtaceae, which have assisted research into the taxonomy of these plants, as well as furthering her work on flora of conservation significance.

Notes. *Euryomyrtus patrickiae* was previously referred to by the informal geographic name *Euryomyrtus* sp. Golden Grove (*S. Patrick* 2679).

No brachyblasts (short-shoots) were observed, all inflorescences being axillary monads. As in some other species, the staminophore is sinusoidal and this accentuates the difference in length of the antepetalous and antesealous filaments as the latter occur in the troughs and the former on the crests.

The seeds seen were not mature as the embryo was not developed, however the shape was definitely reniform, the testa was quite thick and had developed a colliculate surface and the aril was about half the length of the seed. The hilum is fairly small, about a fifth of the length of the immature seeds (possibly less when they are mature).

6. *Euryomyrtus ramosissima* (A. Cunn.) Trudgen, *comb. nov.*

Synonyms and illustrations. See under the two subspecies.

Shrub, erect to spreading to procumbent to prostrate, diffuse to dense, woody or rarely lax, usually with short branchlets from the main stems, 5–60 cm tall, glabrous except for leaves. *Leaves* half overlapping to densely packed and spreading or distant to just overlapping and appressed on rapidly growing stems, petiolate; lamina linear to linear-lanceolate or ovate-lanceolate to spatulate, not to slightly thickened, flat or shallowly concavo-convex, 2–14 mm long, 0.7–3.0 mm wide, acuminate to

rounded, with no distinct veins, dotted with oil glands, margins and less often lamina scabrous (trichomes sub-conic, short, hard, translucent), margins sometimes recurved; petiole 0.2–1.0 mm long; lamina discolorous when margins recurved. *Flowers* 1–16 per branchlet on 1- or 2-noded terminal and axillary brachyblasts bearing 1–4 monads; peduncles subtended by a very reduced leaf c. 0.3 mm long or sometimes by a normal leaf, 1.0–9.0 mm long, terminated by a pair of sub-opposite to alternate bracteoles; anthopodium 1.0–7.0 mm long; bracteoles cordate to rhomboid, very concave, attachment broad, 0.6–2.0 mm long, not thickened, margins ciliolate to erose-ciliolate. *Hypanthium* obconic to broadly obconic, 2.0–3.0 mm diam., smooth, oil glands not very obvious; calyx lobes erect to slightly spreading, transversely semi-elliptic to semi-circular to semi-elliptic or deltoid, 0.9–1.8 mm long, 1.3–1.8 mm wide, not keeled, centres reddish, margins ciliolate to erose-ciliolate. *Corolla* 3.0–15.0 mm diam., pure white, white tinged with red to brilliant pink or mauve-purple; petals spreading, sub-orbicular to orbicular or very broadly ovate to almost oblong, claw very short. *Processes* 5–15 at base of adaxial side of petals, 0.2–0.9 mm long, reddish. *Stamens* 3–10, one opposite each petal and one opposite each calyx lobe when 10, when less than 10 those opposite the petals predominant. *Filaments* sub-terete to very slightly flattened (rarely quite flattened), tapering towards apex, antepetalous longest, equalling or just exceeding calyx lobes, 0.5–1.8 mm long. *Anthers* 0.3–0.75 mm long; connective gland obovoid, 0.2–0.3 mm diam. *Ovary* 3-locular, lower 3/4 fused to hypanthium, top slightly exceeding staminophore; placentas elliptic, c. 0.3–0.4 mm long, broadly attached at centres; ovules 3–5 per loculus. *Style* stout, sub-cylindrical, deeply inserted into top of ovary, equalling antepetalous anthers or rarely markedly exceeding them. *Undehisced fruit*: hypanthium hemispherical, capsule globular, just to 1/3 exceeding calyx lobes. *Dehisced fruit*: capsule opening very widely. *Seeds* reniform, 1.3–1.6 mm long; aril present; testa colliculate, chestnut brown, dull.

Distribution. See beneath the subspecies, below.

Notes. This species has been intensively studied by Carr (1980), who recognized two subspecies, but also noted some specimens intermediate between them and three variants within subsp. *ramosissima*. His concepts are followed here and the key and descriptions below are based on his work, which should be consulted for further details of variation and extensive specimen citations. Carr also provided a distribution map of the subspecies and intermediates, an account of the nomenclatural history of the species complex and observations on insects visiting the flowers.

Carr described the bracteoles as connate, but while they do overlap each other they are not fused and so the term is inappropriate. He also erred in considering that the closest relatives of *E. ramosissima* to be *B. crassifolia* and *B. ericaea*, as while these species are related, the closest relative is *E. denticulata*, followed by the other members of the genus *Euryomyrtus*.

Noting that the flowers of both subspecies were protandrous, Carr (1980) stated that “after the anthers dehisce the style elongates bringing the capitate stigma to the level of the anthers opposite the petals where it matures”. However, some specimens have the style markedly exceeding the antepetalous stamens. Carr also noted that the seeds “are not actively dispersed but drop freely from the inverted capsules”. However, the seeds are arillate and the aril may be attractive to ants, which may then distribute the seeds.

Some specimens have an extra bracteole on some flowers, either below (and at right angles to) the usual sub-opposite/alternate pair or above them near the base of the hypanthium.

Key to subspecies of *Euryomyrtus ramosissima*

1. Flowers erect, corolla (5)7–10(15) mm diam., petals white or mauve-purple.
Floral trichomes 2–15, always present. Stamens 10 or rarely fewer subsp. **ramosissima**
1. Flowers nodding, corolla 3–5 mm diam., petals white, \pm tinged with red
above or below. Floral trichomes few or absent. Stamens (3)5–10 subsp. **prostrata**

6a. *Euryomyrtus ramosissima* (A. Cunn.) Trudgen subsp. **ramosissima**

Baeckea ramosissima A. Cunn. in B. Field, Geog. Mem. New South Wales: 349 (1825). Type: Blue Mountains, New South Wales, *Cunningham* 1822 (holo: K, n.v.).

Baeckea diffusa Sieber ex DC., Prodr. 3: 320 (1828). – *Euryomyrtus diffusa* (Sieber ex DC.) Schauer, *Linnaea* 17: 239 (1843). Type: Nova Hollandia (Port Jackson area), [New South Wales], *F.W. Sieber* (G-DC, n.v.).

Baeckea diffusa var. *striata* DC., Prodr. 3: 320 (1828). Type: Nova Hollandia (Port Jackson area), [New South Wales], *F.W. Sieber* (G-DC, n.v.).

Baeckea alpina Lindl. in T.L. Mitch., Three Exped. E. Australia 2: 178 (1838). – *Euryomyrtus alpina* (Lindl.) Schauer, *Linnaea* 17: 239 (1843). Type: Mt William, Grampians, [Victoria], 1836, *T.L. Mitchell* (holo: CGE, n.v.; iso: K, n.v.).

Baeckea thymifolia Hook.f. in Hook., *Icon. Pl.* 3 (2): t. 284 (1840). – *Euryomyrtus thymifolia* (Hook.f.) Schauer, *Linnaea* 17: 239 (1843). Type: South Esk River, Tasmania, *R.C. Gunn* 86 (lecto: K, n.v., fide Carr (1980)).

Baeckea affinis Hook.f. in Hook., *Icon. Pl.* 3 (2): t. 284 (1840). Type: Elizabeth River, Campbell Town, Tasmania, *R.C. Gunn* 683 (holo: K, n.v.).

Euryomyrtus stuartina F. Muell. ex Miq., *Ned. Kruidk. Arch.* 4: 149 (1856). Type: “Ad fl. South Esk River”, Tasmania, *F. Mueller* (holo: L, n.v.; iso: MEL).

Euryomyrtus leptospermoides F. Muell. ex Miq., *Ned. Kruidk. Arch.* 4: 149 (1856), *nom. nud.*

Illustration. Carr (1980: Figure 2).

Rigid, erect to prostrate or procumbent *shrub* 5–60 cm high, sparsely branched to densely matted. *Leaves* linear-lanceolate to ovate-lanceolate or spatulate, 2–13 mm long, 1.0–3.0 mm wide, acute to obtuse, coriaceous. *Inflorescences* solitary or rarely paired, erect at anthesis, later deflexed. *Petals* 2.0–4.5 mm wide. *Ovules* usually 5 per loculus. *Capsule* 4–4.5 mm diam.; seeds 3 or 4 per loculus.

Selected specimens examined. NEW SOUTH WALES: Royal National Park, c. 2 km W of Bundeena, *G.W. Carr* 7042, 7048 (AD, CANB, LTB, NSW).

SOUTH AUSTRALIA: near Mt Jagged telephone exchange on the Adelaide to Victor Harbour road, *G.W. Carr* 7062–7064 (AD, CANB, LTB, NSW).

TASMANIA: South Esk River, Launceston, *Gunn* 89 (NSW).

VICTORIA: Three Jacks Wildflower Reserve near Stawell, *G.W. Carr* 7094–7108 (AD, CANB, LTB, NSW).

Distribution. From Coffs Harbour to near Sydney, New South Wales; on the western part of Kangaroo Island and the Fleurieu Peninsula South Australia; in the eastern part of Tasmania from coastal and inland localities; mostly in inland localities in Victoria, but not the far east or west, coastal in the far south west at Frankston and near Mt Richmond.

Habitat. "... occurs from 30° 18' to 43° 23' S of latitude, from sea level to 1930 m, in forest woodland or heath in acidic often infertile soils derived from sandstone, shale, granite or dolerite, and in localities between which the range in mean annual rainfall is 500–1900 mm" (Carr 1980).

6b. *Euryomyrtus ramosissima* subsp. *prostrata* (Hook.f.) Trudgen, *comb. nov.*

Baeckea prostrata Hook.f. in Hook., *Icon. Pl.* 3 (2): t. 284 (1840). – *Baeckea ramosissima* subsp. *prostrata* (Hook.f.) *G.W. Carr, Telopea* 1(6):416 (1980). *Type:* Circular Head, Tasmania, *R.C. Gunn* 816 (*holo:* K, *n.v.*).

Euryomyrtus parviflora F. Muell. ex Miq., *Ned. Kruidk. Arch.* 4: 149 (1856). *Type:* Georgetown, Tasmania, *C. Stuart s.n.* (*holo:* L, *n.v.*; *iso:* MEL).

Illustration. Carr (1980: Figure 1).

Procumbent or prostrate *shrubs* 8–20 cm high, erect when young, branches slender, rigid or lax, usually sparsely branched. *Leaves* linear to linear-lanceolate, 3–10 mm long, 0.7–1.5 mm wide, acute or acuminate, chartaceous. *Inflorescences* sparser than in subsp. *ramosissima*, solitary, deflexed at anthesis. *Petals* 1.0–2.5 mm wide. *Ovules* usually 4 per loculus. *Capsule* 3–4 mm diam.; seeds 2 or 3 per loculus.

Selected specimens examined. NEW SOUTH WALES: Nadgee Nature Reserve, 2.2 km N of Little River estuary, *Cameron* 4785 (LTB, NSW).

TASMANIA: Little Badger Head, Asbestos Range, 57 km NW of Launceston, *G.W. Carr* 6646, 6647, 6648, 6649 (AD, CANB, HO, NSW).

VICTORIA: mouth of Seal Creek, SW of Mallacoota, *Cameron* 199A, B, C, D, E, (AD, CANB, CBG, NSW).

Distribution. "Southern coastal New South Wales; coastal Victoria, discontinuously from near Mallacoota to Moonlight Head in western Victoria, with an isolated non coastal occurrence in the Grampians; Tasmania, on the northern and western coasts" (Carr 1980).

Habitat. "... confined to heaths or heathy woodlands within c. 8 km of the coast, except for an isolated occurrence in the Grampians... In the Grampians it usually occurs at lower altitudes than does subsp. *ramosissima*" (Carr 1980).

7. *Euryomyrtus denticulata* (Maiden & Betche) Trudgen, *comb. nov.*

Baeckea denticulata Maiden & Betche, *Proc. Linn. Soc. New South Wales* ser. 2, 34: 360 (1909). *Type:* Kybean, 3800 feet high, near the Kydra Trigonometrical Station, east of Nimitybelle, New South Wales, November 1908, *R.H. Cambage* (*holo:* NSW, *iso:* CANB, MEL).

Illustration. Plate xxxii, *Proc. Linn. Soc. New South Wales* ser. 2, 34 (1909).

Prostrate, mat forming “shrub” usually with slender branches and short divaricate branchlets. *Leaves* opposite, twisted into 2 rows in one plane, spreading to 90° from the branchlets; petiole 0.5–1.0 mm long; lamina slightly curved (rather than flat) with slightly recurved margins, elliptic to broadly elliptic, ovate or oblong, not thickened, 1.6–7.1 mm long, 1.1–3.3 mm wide, acute to obtuse, discolorous (paler below), smooth, green or reddish, oil glands visible on abaxial surface only, margins denticulate-ciliate (trichomes short, hyaline). *Flowers* 1–8 per branchlet on 1-noded terminal and axillary brachyblasts, each peduncle subtended by a reduced leaf, each peduncle subtended by a very reduced leaf 0.6–1.0 mm long, or rarely flowers solitary in the axil of a normal leaf; anthopodium 0.6–1.8 mm long peduncle 0.8–7.0 mm long, terminated by a pair of sub-opposite to alternate bracteoles (up to 0.5 mm apart); bracteoles broadly ovate, not thickened, very concave, attachment broad, 1.0–1.4 mm long, reddish, clasping young bud. *Hypanthium* narrowly to broadly obconic, 1.5–1.7 mm long, 1.3–2.0 mm diam., smooth, pale-coloured or a dull red; calyx lobes spreading, narrowly deltoid to deltoid, 1.5–1.7 mm long, not keeled, red, margin entire or with a few short hyaline trichomes. *Corolla* 5.5–7.0 mm diam., white to pale pink; petals broadly elliptic, ovate, oblong or sub-orbicular, claw very short. *Processes* absent. *Stamens* 19–25, one opposite each petal and calyx lobe the others between these. *Filaments* very slender, terete, tapering very slightly towards apex, not curved inwards at apex, antepetalous longest, markedly exceeding calyx lobes, 2.5–3.2 mm long, antesealous shortest, 1.5–2.0 mm long. *Anthers* c. 0.3 mm long; connective gland sub-globular, c. 0.3 diam. *Ovary* 3-locular, lower third to half fused to hypanthium, top hemispherical, umbiculate, equalling staminophore; placentas slightly raised almost square areas on the floral axis, c. 0.2 mm long; ovules 2 per loculus, collateral, or rarely a third present. *Style* slender, tapering slightly towards stigma, inserted into top of ovary, equalling antepetalous anthers. *Mature fruit* unknown. *Seeds* not seen at maturity; aril present.

Specimens examined. NEW SOUTH WALES: head of Bumberry Creek, SW of Countegany, D.F. Blaxell 485 (MEL, NSW); Bumberry Creek on the Wadbilliga fire trail, 39 km ESE of Cooma, R.G. Coveny 6597, P.D. Hind & M. Parris (A, CANB, K, L, LE, MEL, MO, RSA); Kydra trigonometrical point, Kybean Range, 36° 25' S, 149° 31' E., M. Parris CBG 7907576 (CBG); Bumberry Creek crossing, Wadbilliga Gorge trail, M. Parris CBG 7907577 (CBG); Kosiusko National Park, Marangle Range, on Manjar fire trail between Manjar and Mt Black Jack, M. Parris CBG 850315 (CBG, NSW, PERTH); Conways Gap NE of Kybean, 36° 16' S 149° 32' E, I.R. Telford 8573 (CBG, NSW, PERTH); Kydra trigonometrical point, c. 40 km ESE of Cooma, J.H. Willis MEL72712 (MEL).

Distribution. Found only in a small area of south-western New South Wales with most specimens from near the Kydra trigonometrical point or from the nearby Bumberry creek and one from the Marangle Range near Mt Black Jack to the south-east.

Habitat. Known from under *Eucalyptus viminalis* and *E. pauciflora* on granite with *Grevillea victoriae*, *Acacia lucasii*, *A. rubida*, *Bursaria spinosa* and other shrubs and also from *Allocasuarina nana* heath where it was scrambling over rocks. It occurs in quite high areas, from 950–1300 m above sea-level.

Flowering time. Flowers through a considerable part of the year with flowering specimens having been collected in April, August, October and November.

Conservation status. Although only known from a few specimens from a restricted area *Euryomyrtus denticulata* is apparently locally common, notwithstanding this it is in need of surveying to determine its exact status, it is certainly very poorly collected and very restricted geographically.

Notes. *Euryomyrtus denticulata* is closest to *E. ramosissima* and has been confused with it, but differs in many respects, for example in the number of stamens.

Maiden & Betche (1909) placed *E. denticulata* in section *Euryomyrtus* of *Baeckea*, correctly recognizing its affinities. However they misinterpreted the terminal inflorescence, describing it as an umbel which they claimed as unique for *Baeckea*. However, they also gave an alternative description "flowers axillary in the crowded uppermost leaves which are reduced to bracts", a reasonably accurate description of the brachyblast inflorescence which is also found in all other *Euryomyrtus* species except *E. maidenii* and *E. patrickiae*. In *E. denticulata* a flowering branchlet may have just a terminal brachyblast or a terminal brachyblast and up to four axillary brachyblasts. The growing tips of the brachyblasts often grow on, before flowering is finished, producing normal leaves.

The holotype bears the date "4-11-08" and collector's number 1990, which were not quoted in the original description. In a separate publication the collector noted "An interesting *Baeckea* (No. 1990) was found plentifully over the sandy conglomerate hills, at elevations up to 4,00 feet. The plant is quite prostrate, spreading from 1–2 feet across, and early in November is charmingly crested with a profuse display of white flowers, in some cases very faintly tinged with pink." (Cambage 1909).

Acknowledgements

The preparation of this paper was made possible by financial support from the Australian Biological Resources Study. The author is indebted to Mr P.G. Wilson for translating the descriptions of the new species into Latin and the original description of *Euryomyrtus* into English. Loans of specimens were kindly made by the curators of AD, BRI, CANB, CBG, MEL and NSW. Thanks are also given to the curator of the Western Australian Herbarium for allowing access to that institution's collection and library and for obtaining the loans.

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Agonis fragrans (Myrtaceae), a new species from Western Australia

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Abstract

Wheeler, J.R., Marchant, N.G. and Robinson, C.J. *Agonis fragrans* (Myrtaceae), a new species from Western Australia. *Nuytsia* 13(3): 567–570 (2001). *Agonis fragrans* J.R. Wheeler & N.G. Marchant is described and illustrated. This species, previously recognized by the cut-flower industry by informal names, now requires scientific recognition to further its development for an essential oil. The differences between this species and *A. juniperina* Schauer are discussed.

Introduction

Interest in species of *Agonis* (Myrtaceae) by the essential oil industry has led to the need for the formal recognition of this species ahead of a revision of the genus. *Agonis fragrans* has been recognized for many years by the cut-flower industry as Coarse tea-tree or Coarse Agonis, but only relatively recently has one of us (Chris Robinson) recognized it as a potential source of essential oil. It is in this latter context that a formal name is necessary to further its development.

Description

Agonis fragrans J.R. Wheeler & N.G. Marchant, *sp. nov.*

Agonis juniperina affinis, sed habitu fruticoso lignotuberoso, foliis grossis, fasciculis florum magis, bracteis bracteolisque latis a congeneribus diversa differt.

Typus: Marbellup Rd North, 6.2 km north of South Coast Highway, Western Australia, 26 July 2000, J.R. Wheeler 4044 (*holo:* PERTH; *iso:* AD, CANB, K, MEL).

Shrub to 2.4 m high, lignotuberosus. *Branchlets* with both short hairs and long pilose hairs. *Leaves* alternate, spreading and somewhat rigid, subsessile, linear to very narrowly elliptic, 7–22 mm long, 0.7–2(2.5) mm wide, entire, upper surface slightly concave when dry, glabrous apart from short hairs

towards the base of the upper surface and also sometimes sparse marginal hairs, with only the base of the midrib evident on the lower surface; base tapered; apex acute and somewhat shortly mucronate. *Flower clusters* axillary or terminating short axillary shoots, several- to many-flowered, globular or semi-globular to ovoid, (7)10–15 mm diam. *Flowers* sessile, 6–9 mm diam., subtended by a bract and 2 bracteoles. *Bract* broadly ovate to broadly obovate or circular, 2–3 mm long, 2.5–4(5) mm wide, concave, glandular-punctate and somewhat verrucose on the keel, glabrous or with a few hairs outside, particularly on the keel and with fine appressed hairs inside in the lower half; apex obtuse or very obtusely acuminate with a minute apiculum, the apex of the outer bract to the whole cluster sometimes more acute. *Bracteoles* 2, broadly elliptic or broadly obovate to very broadly obovate or circular, 2.5–3 mm long, 2–4 mm wide, concave, glandular-punctate and usually somewhat verrucose on the keel, glabrous or with some hairs particularly on keel; apex obtuse or emarginate. *Hypanthium* obconic, 1.5–2.5 mm long, rugose, irregularly puberulous but often sparsely so, also with a tuft of hairs at the base. *Sepals* 5, persistent, white, ovate-triangular, (1.2)1.5–2 mm long, glabrous, acute to subacute. *Petals* 5, persistent, white but sometimes tinged pink in bud and with a pinkish claw, with a broadly obovate to circular limb 2–3 mm diam. *Stamens* 10, one opposite each sepal and each petal; filament incurved, 0.5–0.8 mm long; anther elliptic, 0.3–0.4 mm long. *Ovary* summit glabrous; ovules (2)3 per cell. *Style* 0.5–1.8 mm long. *Fruit clusters* globular to ellipsoid, 8–10 mm long, 8–10 mm wide; capsules broadly turbinate to cup-shaped, 2–3.5 mm long, 2.5–3.5 mm wide, puberulous and with a basal hair tuft. (Figures 1, 2)

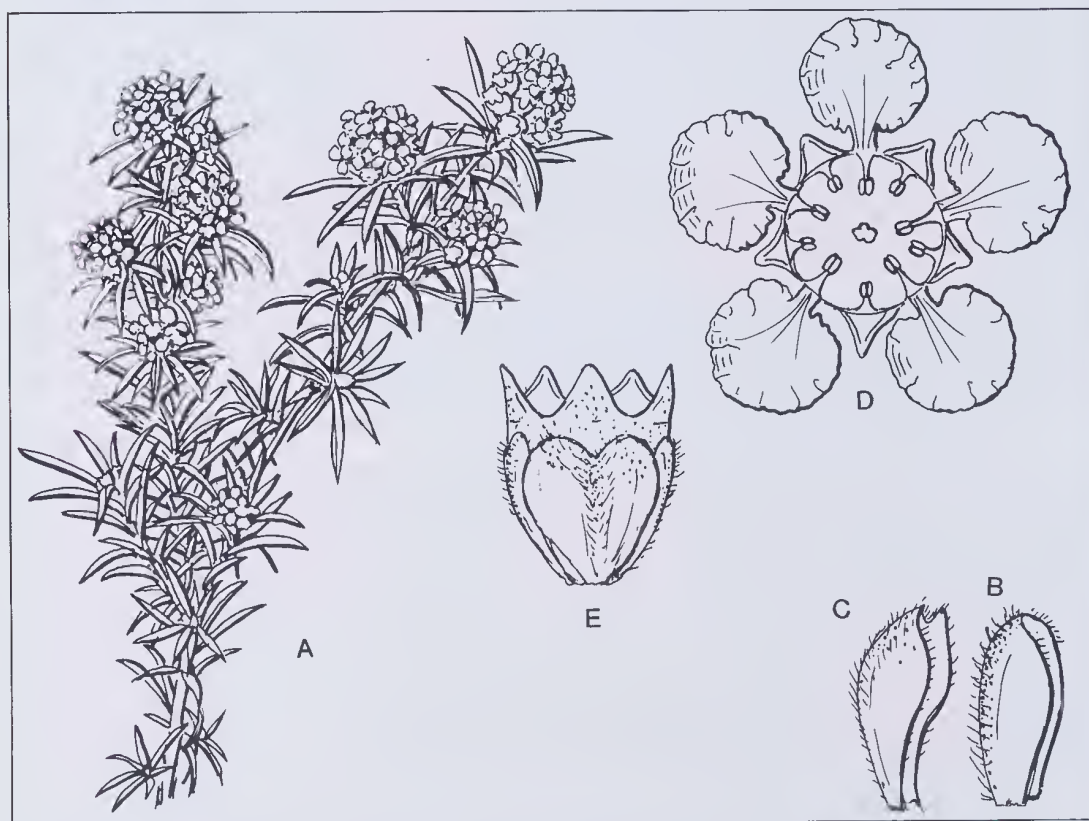


Figure 1. *Agonis fragrans*. A – flowering branch, B – bract, C – bracteole, D – flower, E – young fruit with bracteole (petals removed).

Selected specimens examined (all PERTH). WESTERN AUSTRALIA: Walpole–Nornalup National Park point 305, 3 May 1989, *A.R. Annels* 732; Plot 5022, Romance Rd, 2 km N of Break Rd, 28 km NW of Denmark, 20 Nov. 1991, *A.R. Annels* 2006; Payne Rd, c. 4.5 km E of Bussell Highway, c. 14 km NE of Cowaramup, 31 May 1995, *B.J. Lepschi* 1867 (duplicates AD, BRI, CANB, NSW, US all *n.v.*); Storry Rd off Pemberton–Nannup road adjacent to private property on Donnelly River, State Forest Jasper, 23 June 1991, *N. McQuoid* 171; Site B53, 600 m along unnamed track off Nanga Rd, 500 m N of intersection with Willowdale Rd, 24 July 1997, *G. Paull* 248; N side of Kernutts Rd, 1.3 km E of Denmark–Mount Barker road and 3.6 km N of Albany–Denmark highway, 29 Jan. 1998, *C.J. Robinson* 1208; Peter Buxton's property, Plantaginet Location 6634 Redmond West Rd, 18 km WSW of Redmond townsite (cultivated from locally collected seed – oil voucher), 18 Feb. 1998, *C.J. Robinson* 1213; 135 mile post on Albany Highway (between Williams & Kojonup), Oct. 1966, *W. Rogerson* 292; Site 133, 2.5 km SE of Mt Johnstone, 4 Sep. 1997, *D. Trenowden* 195; Gum Link Rd, W of Nornalup Rd, 10 Aug. 1991, *J.R. Wheeler* 2667; Walpole–Nornalup National Park, Nut Rd, 1 Sep. 1991, *J.R. Wheeler* 2939; Walpole–Nornalup National Park, 0.5 km E of Deep River bridge, track opposite Meredith Rd, 10 Aug. 1992, *J.R. Wheeler* 3098.



Figure 2. Photograph of flowering branch of *Agonis fragrans* taken by C.J. Robinson.

Distribution. Occurs from Nillup and Lake Jasper to east of Denmark from Redmond and Marbellup, with a single record from between Williams and Kojonup.

Habitat. Occurs in swamps on acid peaty sand and in the seasonally waterlogged margins of broad upper valleys, often in association with *Beaufortia sparsa* and *Homalospermum firmum*. *Agonis fragrans* often occurs near *A. parviceps* Schauer (but usually lower in the profile), although the latter species is found in a great variety of habitats. Also found near *A. juniperina* Schauer of swamps and waterways.

Phenology. Flowers mostly January to May but petals persist throughout fruiting.

Etymology. The name reflects the fragrant nature of both the foliage and the extracted oil.

Conservation status. Recorded from a number of localities within a wide distribution. Not believed to be threatened.

Notes. *Agonis fragrans* was previously recognized at the Western Australian Herbarium as *Agonis* sp. Coarse tea-tree (*J.R. Wheeler* 2939) and as *Agonis* sp. Coarse Agonis (*J.R. Wheeler* 2939). It has been recognized under the former name by the Export Flora list and as "Coarse tea-tree" by the cut-flower industry. Prior to the use of these informal names, the species was confused with *Agonis juniperina*.

Agonis fragrans can be distinguished from *A. juniperina* in its habit and flowering time as well as in its foliage and flowers. *A. juniperina*, commonly known as Wattie or Warren River Cedar, is a large tree with shorter softer leaves, whereas *A. fragrans* is a shrub with thicker and more rigid leaves. *Agonis juniperina* has smaller clusters of smaller flowers, which have slightly shorter and narrower bracts and bracteoles as well as smaller sepals and petals. *Agonis fragrans* has erect flowering branches whereas *A. juniperina* has somewhat weeping flowering branches. *Agonis fragrans* has a lignotuber and reportedly resprouts after fire whereas *A. juniperina* lacks a lignotuber and is recorded as being killed by fire.

Acknowledgements

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A taxonomic revision of the Western Australian genus *Lysiosepalum* (Malvaceae: Lasiopetaleae)

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Abstract

Wilkins, C.F. & Chappill, J.A. A taxonomic revision of the Western Australian genus *Lysiosepalum* (Malvaceae: Lasiopetaleae). *Nuytsia* 13(3): 571–594 (2001). A taxonomic revision of *Lysiosepalum* F. Muell., a genus endemic to south-western Australia, identified five species. These comprise two currently accepted species *L. involucratum* (Turcz.) Druce and *L. rugosum* Benth., the reinstated *L. hexandrum* (S. Moore) S. Moore and two new species *L. abollatum* C.F. Wilkins (CALM Priority One) and *L. aromaticum* C.F. Wilkins (CALM Priority Two) that probably require recognition as Declared Rare Flora.

A cladogram based on morphological data indicates that *Lysiosepalum* is a monophyletic genus, strongly supported by three synapomorphies unique in tribe Lasiopetaleae: calyx tube very short (lobes scarcely fused at the base); calyx lobes of alternating broad and narrow widths; epicalyx bracts equally spaced to completely enclose the mature bud.

A chromosome number of $n = 10$ for *L. involucratum* is the first published record for the genus.

Introduction

Lysiosepalum F. Muell. is an endemic south-western Australian genus of five species. It has traditionally been placed in Sterculiaceae, but this family is now included in the greatly expanded Malvaceae (*sensu* Judd & Manchester (1997), supported by Alverson *et al.* (1998), the Angiosperm Phylogeny Group (1998) and Bayer *et al.* (1999)). *Lysiosepalum* belongs to the tribe Lasiopetaleae (Gay 1821) a group characterized by being apetalous or having much reduced scale-like petals, having subulate non-petaloid staminodes and non-versatile anthers with contiguous, connate lobes.

Mueller (1859) named the genus from the Greek – *lysis*, meaning loosening or releasing and the Latin – *sepalum*, meaning sepal (Brown 1954), in reference to the almost free calyx lobes. The genus was typified by *Lysiosepalum barryanum* and the epithet honoured Redmond Barry, then Chancellor of Melbourne University. However, Turczaninow (1852) had already described this species as *Thomasia involucrata*, which Druce (1917) subsequently transferred to *Lysiosepalum* (*L. involucratum*).

Thomasia involucrata was described correctly as six-merous by Turczaninow (1852), however, the usually hexamerous feature of *Lysiosepalum* was not consistently recognized in following treatments. Mueller's (1859) generic description stated that *L. barryanum* was five-merous, rarely having six stamens and sepals, and Bentham (1863) erroneously described *L. rugosum* as five-merous. Type specimens and other collections of these original species of *Lysiosepalum* are, however, all six-merous. Confusion was still apparent when Moore (1921) described a third new species *Thomasia hexandra* Moore, the epithet referring to the six-merous flowers. When he later examined *Lysiosepalum* held at BM and Australian herbaria (unnamed), he found them to be hexamerous and subsequently transferred the taxon to *Lysiosepalum* (Moore in Sargent 1923). This species, although currently not recognized (Hnatiuk 1990), having previously been reduced to synonymy of *L. involcratum* (Blackall & Grieve 1956), is reinstated here as a distinct species. Of the two additional species described in this revision, one is 6-merous and the other is 4- or 5-merous.

As there has been no comprehensive treatment of *Lysiosepalum* since "Flora Australiensis" (Bentham 1863), this paper presents a formal revision of the genus as part of a revision of Lasiopetaleae in preparation for "Flora of Australia" Volume 7. In addition, a lack of published information on anatomy, cytology and phylogeny of the genus is redressed.

Methods

This revision is based primarily upon morphological evidence obtained from examination of vegetative, and fresh and rehydrated flowering material from collections, including type specimens, from the following national and international herbaria; AD, BM, BRI, CANB, CBG, DNA, K, MEL, NSW, P, PERTH, W. All defined taxa have been examined in the field.

Seed-coat morphology was examined on seeds from the authors' field collections, or those of Kings Park Botanic Garden (KPBG). Examination of pollen exotesta of *Lysiosepalum involucratum* (KPBG 196/86, identity verified from seedlings) was facilitated by an Environmental Scanning Electron Microscope (Danilatos 1993). Seedlings were grown of *L. hexandrum* (C.F. Wilkins 737), *L. involucratum* (KPBG 196/86) and *L. rugosum* (C.F. Wilkins 732). Seeds were pre-treated by being covered with boiling water and soaked overnight. Seeds were germinated in petri dishes on filter paper moistened with 1% Previcur fungicide and those with emergent radicles were transferred to pots of potting mix in a glasshouse.

Anatomy and cytology. Anatomical comparison of fresh plant material was facilitated by fixing in glutaraldehyde, embedding in GMA resin, sectioning by microtome and staining with Toluidine Blue pH 4.4 (Feder & O'Brien 1968). To observe chromosome number, fresh anthers were fixed in 3:1 absolute ethanol: glacial acetic acid for 24 hours, rinsed in 70% ethanol and stained in alcoholic hydrochloric acid carmine for two days. Anthers were squashed in 45% glacial acetic acid and chromosomes from meiotic pollen mother cells were micrographed using a Zeiss Axiophot microscope and 6 ASA Imagelink film.

Cladistic analysis. A data set of five identified species of *Lysiosepalum*, two outgroup taxa and 25 morphological characters was established in MacClade 3.05 (Maddison & Maddison 1992). *Thomasia angustifolia* Steud. and *Guichenotia angustifolia* (Turcz.) Druce were chosen as outgroup taxa as a cladistic analysis of all species of Lasiopetaleae (unpublished data) shows *Lysiosepalum* to be monophyletic and *Guichenotia* and *Thomasia* to be closely related with similar stipules, and anthers dehiscing by apical pores. The outgroup species chosen retain the plesiomorphic features of these

genera. Binary and both quantitative and qualitative multistate characters were included (Table 1). Multistate characters which represented logical progressions in size or shape were treated as ordered, while the remainder were left unordered. Where more than one character state was present within a taxon, the taxon was coded as polymorphic. The resulting data matrix is presented (Table 2).

Character definitions are self-explanatory except for character 5 where crisped margins are defined as being wavy or undulate, character 14 where hair density is defined as scattered when the hairs are well separated, medium density when the hairs are just touching laterally, dense when the hairs are strongly overlapped with the epidermis remaining visible, and tomentose where hair density conceals the epidermis. For character 19 anther pores are described in this revision as being in the apical position, but they may originate basally. A study of anther development (Heel 1966) in *Thomasia*, which is similar in anther morphology to *Lysiosepalum*, showed the anther being resupinate in early development. In this study, the terminal pores are treated as being homologous in *Thomasia*, *Guichenotia* and *Lysiosepalum*.

Table 1. Characters scored for five *Lysiosepalum* and two outgroup taxa. Multistate characters 2, 4, 8, 12, 14, 16, 20, 22 were ordered and the rest were unordered. Consistency and retention indices from the single shortest tree, are indicated in brackets for each character.

-
1. Adult leaf orientation: 0 = horizontal or reflexed; 1 = erect (1.0, 1.0).
 2. Adult leaf petiole length: 0 = 6–4.6 mm; 1 = 4.5–3.1 mm; 2 = 3.0–1.6 mm; 3 = 1.5–0 mm (0.8, 0.667).
 3. Adult leaf base: 0 = attenuate; 1 = cordate (1.0, 0.0).
 4. Adult leaf margin: 0 = flat; 1 = recurved; 2 = revolute (1.0, 1.0).
 5. Adult leaf margin: 0 = straight; 1 = crisped/wavy (0.5, 0.5).
 6. Adult leaf shape: 0 = broadly ovate; 1 = narrowly ovate; 2 = narrowly elliptic; 3 = linear (0.857, 0.667).
 7. Flower: 0 = 4–5-merous; 1 = 6-merous (1.0, 1.0).
 8. Glandular hairs on pedicel: 0 = absent; 1 = 0.1–0.4 mm long; 2 = 0.5–0.9 mm long (0.5, 0.333).
 9. Bracteoles in bud: 0 = not enclosing mature bud; 1 = enclosing mature bud (1.0, 1.0).
 10. Bracteole fusion: 0 = absent; 1 = shortly fused at base (1.0, 1.0).
 11. Bracteole shape: 0 = narrowly ovate or narrowly elliptic 3:1 or more; 1 = ovate 2.5:1 or less (1.0, 1.0).
 12. Stellate hairs on bracteole adaxial surface: 0 = scattered; 1 = medium density; 2 = dense; 3 = tomentose (1.0, 1.0).
 13. Stalked, clavate glands on abaxial surface of bracteole: 0 = absent; 1 = present (0.5, 0.0).
 14. Stellate hairs on bracteole abaxial surface: 0 = medium density; 1 = dense hairs; 2 = dense tomentum (1.0, 1.0).
 15. Number of arms in stellate hair on bracteole abaxial surface: 0 = 12–c.25; 1 = 2–12 cells (1.00, 0.0).
 16. Calyx lobes as a % of total calyx length: 0 = 61–70; 1 = 71–80; 2 = 91–100 (1.0, 1.0).
 17. Calyx lobes: 0 = equal widths; 1 = alternating broad and narrow (1.0, 1.0).
 18. Petals: 0 = present; 1 = absent (1.0, 0.0).
 19. Anther dehiscence: 0 = pore only; 1 = pore and split from pore to anther base (1.0, 0.0).
 20. Degree of fusion of anther lobes: 0 = completely fused; 1 = shallow groove; 2 = strongly grooved (1.0, 0.0).
 21. Filament width: 0 = 0–0.3 mm; 1 = 0.4–0.5 mm (1.0, 1.0).
 22. Staminal tube: 0 = absent; 1 = less than 1 mm; 2 = more than 1 mm (1.0, 1.0).
 23. Brittle ovary hairs: 0 = absent; 1 = present (1.0, 1.0).
 24. Base of brittle hairs: 0 = short fused base < 50 % fusion; 1 = long fused base > 50% fusion (1.0, 1.0).
 25. Number of ovules per locule: 0 = 1–8; 1 = more than eight (1.0, 1.0).
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Table 2. Data matrix for a cladistic analysis of *Lysiosepalum* and two outgroup species in *Guichenotia* and *Thomasia*. Missing data are coded as "?".

Taxon	12345	1 67890	11111 12345	11112 67890	22222 12345
<i>Guichenotia</i>	01010	11000	00000	00000	000?0
<i>angustifolia</i>	2 2	3	1	1 1	
<i>Thomasia</i>	02000	21000	00100	00102	000?0
<i>angustifolia</i>	1	3		1	
<i>Lysiosepalum</i>	03011	12111	10101	21012	10101
<i>abollatum</i>	1 1		1 1		1
<i>L. aromaticum</i>	00111	00211 1	10110	21002	00100
<i>L. hexandrum</i>	13020	32211	12120	21002 1	11111 2
<i>L. involucreatum</i>	13020	32111	12120 3	21002 1	11111 2
<i>L. rugosum</i>	01011 1 1	12011	10010 1 2	21012 1	00101 11

Phylogenetic relationships were determined using the program PAUP 3.1.1 (Swofford 1993). The outgroup method (Watrous & Wheeler 1981) was used to polarize characters. Character states were equally weighted for a branch and bound search to look for equally parsimonious trees. Bremer support (Bremer 1994) and bootstrap frequencies (Felsenstein 1985) were used to estimate stability of each node. The total support index Ti (Bremer 1994) was determined by summarizing all Bremer support values for nodes in the cladogram and then dividing the sum by the obtained tree length. A bootstrap analysis (branch and bound) was performed with 1000 replicates.

Results and discussion

Examination of herbarium specimens and fresh material revealed five discrete taxa in *Lysiosepalum*. These are each sufficiently distinct to be recognized as species.

Inflorescence structure. *Lysiosepalum* inflorescences have been incorrectly described as axillary (Mueller 1859) and as racemes (Mueller 1859, Bentham 1863, Moore 1921). Actually they have leaf-opposed, monochasial cymes with 2–12 flowers frequently oriented towards one side of the inflorescence. This study confirms the inflorescence form of *Lysiosepalum* is as described from one species *L. involucreatum*, by Bayer & Kubitzki (1996). The flowering shoots are sympodia with repeating units of two or three vegetative nodes and a terminal inflorescence that is overtopped by the axillary product of the distal leaf which leads to a leaf-opposed inflorescence (Figure 1). This study also confirms that *Lysiosepalum* has the basic repeating *bicolor* unit (Bayer 1999, after *Theobroma bicolor* where it was first observed) which is a synapomorphy for the core Malvales (now circumscribed as Malvaceae, *sensu* Judd & Manchester 1997). The *bicolor* unit is determinate and bears three bracts, one of which is sterile

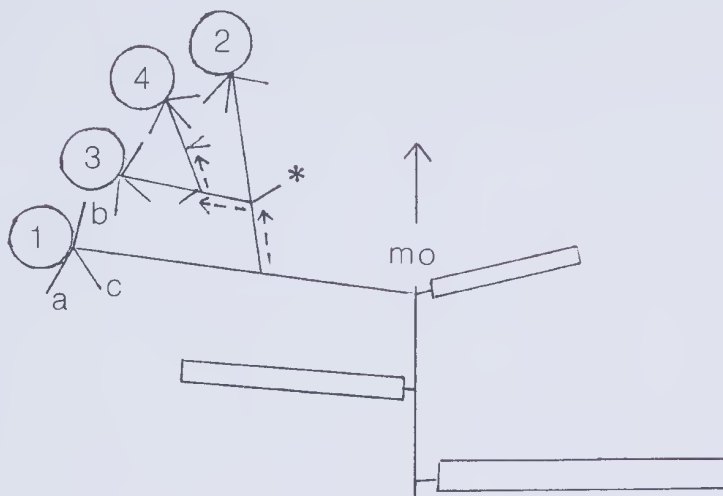


Figure 1. *Lysiosepalum* sympodium with two vegetative nodes and the terminal inflorescence overtopped by the axillary module (mo) of the distal leaf leading to a leaf opposed inflorescence. The monochasial cyme numbers indicate flower order; a,b,c is the epicalyx of the terminal flower (1); broken lines indicate displacements; * is the displaced subtending bract of second flower (after Bayer & Kubitzki 1996).

and the other two subtend lateral cymes, or in single flowers it can be reduced to an epicalyx of three sterile bracts (Bayer 1999). In *Lysiosepalum* flowers have an epicalyx of three sterile bracts, the first flower has no subtending bract (Figure 1), which Bayer & Kubitski (1996) state indicates it is the terminal flower of the inflorescence. The subtending bract of the second and subsequent flowers are situated more distally which Bayer and Kubitski regard as recaulescent displacement.

All except the new species *L. aromaticum* have occasionally been observed with a dichasial cyme co-occurring on the flowering stem with the unbranched cymes. *Lysiosepalum* also has the feature of consistent retention from the previous flowering season of the peduncle and inflorescence stem (without pedicels) which is also observed in some *Thomasia*. They are present on the stem below the flowering, new seasonal growth units.

Seed and seedling morphology. Seed morphology of *Lysiosepalum* is similar to *Thomasia*, *Guichenotia* and *Lasiopetalum* in having sessile, stellate hairs on the testa, and cap-like arils with two longer lobes extended on the hilar surface. *Lysiosepalum* seed has a smooth surface to the naked eye but Environmental Scanning Electron Microscopy revealed the exotesta of *L. involucreatum* and *L. rugosum* to be patterned with longitudinally-elongated, narrowly oblong, epidermal cells. Seed anatomy conforms to Malvales (Corner 1976) in having an exotegmic palisade (detailed description of seed coat and anatomy, Wilkins in prep).

Lysiosepalum seedlings show epigeal, phanerocotylar germination with cotyledons that are petiolate, green, elliptic, entire, glabrous, flat and slightly expanding after germination. First and subsequent leaves of observed species are alternate and entire. The first five leaves are ovate and flat, while from the sixth to seventh node, leaves are oblong, flat and up to four times larger than adult leaves. Progressively they become smaller, more linear and margins recurve, which is the mature form of the

leaf and stipule. In addition, seedling leaves in the glasshouse and in the field, have larger, more scattered, stellate hairs than those present on leaves of mature plants. Stipules are absent on the first two leaves and develop at the third leaf node in all species examined and at that stage seedlings are 1.5–3 cm high.

Anatomy. Transverse sections of leaves of *L. hexandrum* (K.A. Shepherd 68, J.A. Wege 264) and *L. abollatum* (C.F. Wilkins 1213), show them to be dorsiventral. In the uniseriate epidermis there are single cells or groups of cells (Figure 2A) that are larger than the remaining epidermal cells and stain reddish-purple. These are considered to be mucilage cells, as Toluidine Blue stains polycarboxylic acids, including alginic and pectic acid, reddish-purple (Feder & O'Brien 1968). Mucilage cells and canals are reported as characteristic of Malvaceae *s.l.* (Metcalfe & Chalk 1950)). The palisade layer is biseriate or with a poorly organized third layer and the spongy mesophyll cells are loosely packed with obvious air spaces. A bundle sheath around secondary veins is uniseriate (Figure 2B) and consists of moderately thick-walled, achlorophyllous parenchyma. Primary veins are surrounded by two layers of thick-walled parenchyma cells and a crescent of fibres is present directly below the phloem. Species examined are hypostomatic with guard cells that have mucilage inclusions. Crystal druses are present as cell inclusions in the palisade and spongy mesophyll layers (Figure 2A). Cluster crystals of calcium oxalate have been reported as a feature of Malvaceae *s.l.* (Metcalfe & Chalk 1950).

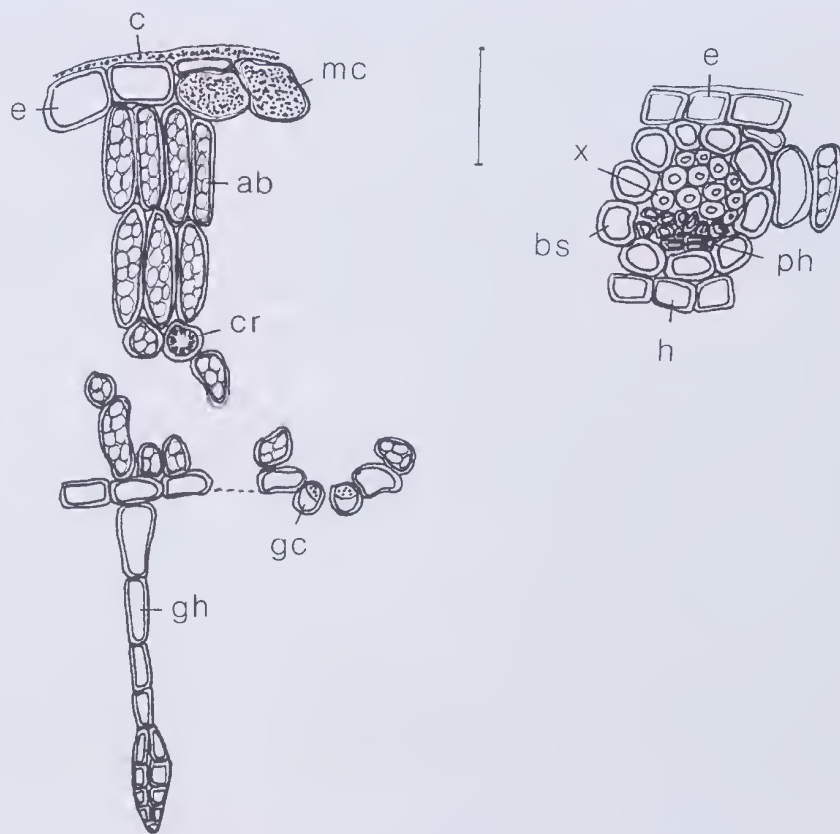


Figure 2. A – transverse section of leaf of *Lysiosepalum abollatum* (voucher C.F. Wilkins 1213). Key to labelling: ab abaxial palisade; c cuticle; cr crystal; e epidermis; gc guard cell; gh glandular hair; mc mucilage cell; scale bar = 0.1 mm. B – secondary vein of leaf of *Lysiosepalum hexandrum* (voucher K.A. Shepherd 68) bs bundle sheath; e epidermis; h hypodermis; ph phloem; x xylem.

Mucilage ducts are also present scattered in pith parenchyma cells of the stem and parenchyma cells in the centre of the anther connective. Transverse sections of *L. hexandrium* petals (voucher K.A. Shepherd 68) reveal three cell layers, being an upper and lower epidermis and a central layer of parenchyma. Two thirds of the cells in the central layer are large mucilage cells. Mucilage cells were, however, absent in the calyx and ovary. Tanniferous cells were not observed in any *Lysiosepalum* sections.

Chromosome number. Meiotic pollen mother cells of *L. involucreatum* (voucher Kings Park Botanic Garden seed 196/1986, Magenta Rd, S of Newdegate) have a chromosome number of $n = 10$ (Figure 3). This chromosome number is common in Malvaceae subfamily Byttnerioideae and agrees with four other counts reported for Lasiopetaleae: $n = 10$ in *Keraudrenia exastia* C.F. Wilkins (Wilkins 1999), $n = 10$ in *Hannafordia bissillii* subsp. *latifolia* (E. Pritz.) C.F. Wilkins and $2n = 20$ in *H. quadrivalvis* F. Muell. subsp. *quadrivalvis* (Wilkins 2001 in press) and $2n = 20$ in *Thomasia solanacea* (Sims) Gay (Federov 1969).

Cladistic analysis. The cladistic analysis resulted in one most parsimonious tree of 64 steps (Figure 4). A bootstrap analysis of 1000 replicates resulted in strong support for nodes one and four and moderate support for nodes two and three. Bremer support values showed the same pattern of support.

Lysiosepalum is a monophyletic genus, supported by three synapomorphies unique in Lasiopetaleae: unequal width calyx lobes (alternating broad and narrow); epicalyx completely enclosing mature buds (due to equally spaced epicalyx bracts rather than unilateral bracts); and calyx lobes that are scarcely fused at the base. Additional synapomorphies that support the *Lysiosepalum* clade are brittle ovary hairs (also found in *Guichenotia macrantha* and many *Thomasia*), epicalyx bracts that are fused at the base (also found in some *Lasiopetalum*), and glandular hairs on the pedicel which are also found in many species of *Guichenotia*, *Lasiopetalum*, *Keraudrenia* and *Thomasia*. The synapomorphy of glandular hairs on the pedicel is subsequently lost in *L. rugosum*.

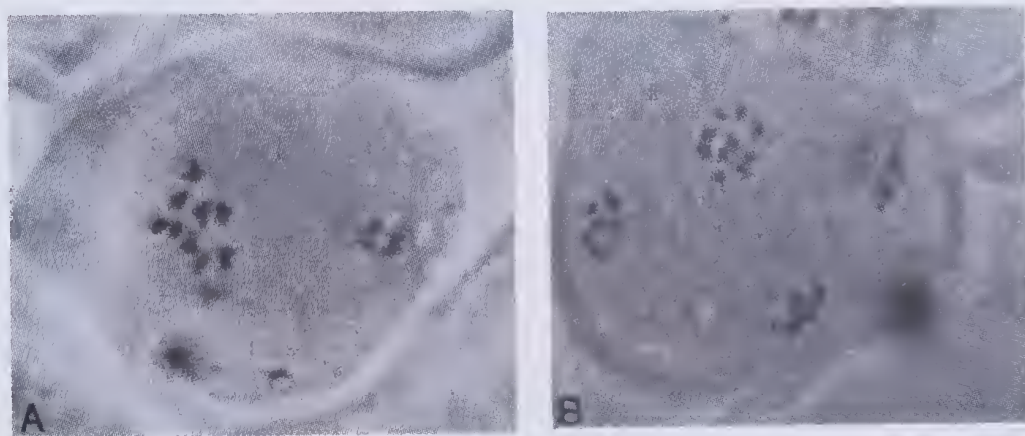


Figure 3. Pollen mother cells of *Lysiosepalum involucreatum* with $n = 10$. A – showing meiotic, first metaphase. B – showing meiotic, second telophase.

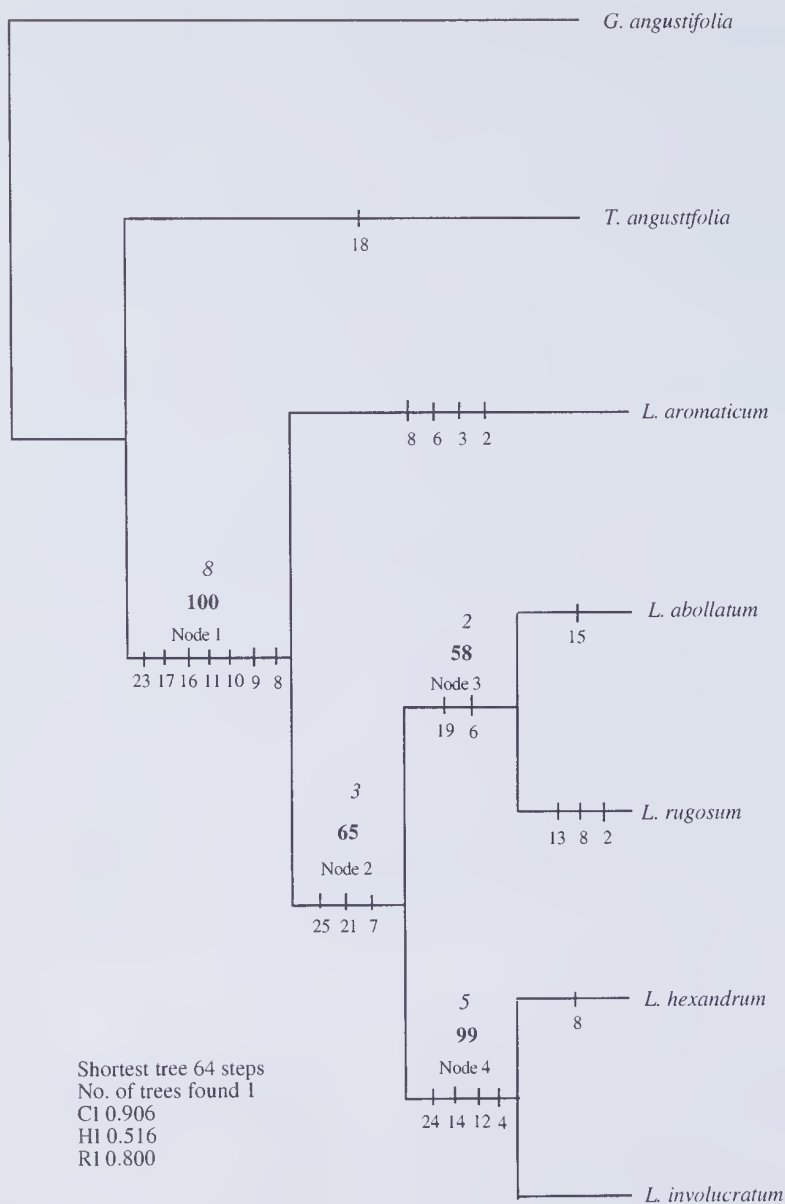


Figure 4. One tree found by a branch and bound search of five *Lysiosepalum* and two outgroup taxa. Numbers below the line are characters changing unambiguously on the branch. Numbers above the line in italics are Bremer support values and in bold are bootstrap frequencies to estimate stability of the nodes.

Lysiosepalum aromaticum is sister taxon to the remainder of the genus. It retains the plesiomorphic feature of a 5-partite calyx. Autapomorphies are long leaf petioles up to 7 mm long, consistently cordate leaf bases, broadly ovate to ovate leaf shape and long glandular hairs on the pedicels. The other four species are delimited at node two by flowers being 6-merous, broad filaments 0.4–0.5 mm wide, and more than eight ovules. *L. rugosum* and *L. abollatum* are sister taxa to the remaining two species *L. hexandrum* and *L. involucreatum* and united at node three by having anthers that split longitudinally from the terminal pore at maturity rather than only poricidal dehiscence. They also have mature leaves

that are narrowly ovate rather than linear. *L. abollatum* is distinct from other *Lysiosepalum* in having stellate hairs on the abaxial surface of the epicalyx bracts that are less than 12-armed. At node four, sister taxa *L. hexandrum* and *L. involucreatum* are united by having leaves with strongly recurved margins rather than slightly recurved; adaxial and abaxial surfaces of epicalyx that are stellate tomentose rather than scattered to medium density; and brittle ovary hairs with long fused bases (> 50 % fusion), rather than short bases (< 50 % fusion). Long glandular hairs on the pedicels distinguish *L. hexandrum* from *L. involucreatum*.

Taxonomy

Lysiosepalum F. Muell. (Mueller 1859: 142–143). Type: *Lysiosepalum barryanum* F. Muell.

Multi-stemmed, compact *shrubs*, peppery scent present or absent, plant surfaces except petals and androecium with indumentum of stalked and/or sessile stellate hairs of mixed sizes, often mixed with short or long glandular hairs. *Young branches* terete, erect, tomentose, mature stems glabrescent. *Stipules* always present or variably present on a stem (*L. involucreatum*), persistent, sessile or stipitate, base oblique, juvenile blade broadly-ovate, mature form ovate or reniform, approximately one tenth of leaf length; leaf-like in having a coriaceous texture, margin slightly or strongly recurved and apex obtuse. *Leaves* alternate, simple, erect, spreading or reflexed, crowded on young growth. *Petioles* long or short. *Blades* grey-green or mid-green, broadly ovate, ovate, narrowly ovate, or linear-oblong, base cordate or attenuate, venation of juvenile leaves pinnipalmate and mature leaves pinnate; adaxial surface with reticulate minor venation and a deeply impressed midrib, either strongly rugose with crisped margin when major and minor veins strongly impressed, or faintly rugose with entire margin when only major veins strongly impressed; abaxial surface with prominent midrib. *Inflorescence* a leaf-opposed, elongate monochasial cyme of 2–8 bisexual flowers, rarely a branched cyme with up to 12 flowers, the peduncle and inflorescence stem always persistent from previous flowering season; peduncle red. *Bracts* none subtending terminal flower, one subtending intermediate flowers and two subtending apical flower, persistent, spatulate or linear, apex acute. *Pedicels* red, often marginally wider at apex. *Epicalyx bracts* three, directly below calyx, persistent, broadly ovate to ovate, equally spaced to completely enclose the mature bud, fused at base 0.3–1 mm, recurved from flowers, partially re-enclosing fruiting calyx. *Flowers* facing downwards, 6-merous except *L. aromaticum* which is 4- or 5-merous. *Calyx* persistent, rotate, with a very short tube and alternating wide flat lobes and narrower lobes that are either flat or with reflexed margins; lobes petaloid, mauvish-pink, narrowly ovate, narrowly elliptic or oblong, the adaxial surface with raised thickened base and impressed veins extending from thickened base to apex and dense indumentum of fine white 2–5-armed stellate hairs to 0.1 mm diam. and simple hairs, the abaxial surface with thickened base and 3–5 prominent ribs extending into the lobe from thickened base. *Petals* absent or present, scale-like, sessile, free, erect or horizontal, dark red or bright red, obovate or obcordate. *Androecium* dark red or bright red; staminodes absent or 3–6, on apex of staminal tube or free, minute, triangular; stamens antepetalous. *Filaments* free or shortly fused into a staminal tube; free portion flattened, broad or narrow. *Anthers* in one whorl, laterally touching at incurved apex to form a tube, with narrow gaps between anther bases, ventrifixed with apex of filament fused to anther surface (ventriadnate), 2-celled, narrowly ovate, with introrse dehiscence from narrowly ovate, subterminal pores, which (in two species) become extended as longitudinal slits at maturity. *Pollen* tricolporate, white, somewhat flattened, elliptic in outline, exine reticulate (Figure 5). *Carpels* laterally connate; ovary sessile, ovoid, 3-locular, placentation axile, outer surface with a dense covering of sessile, brittle, white, stellate hairs with cell bases fused to form a short to long oblong base, inner surface of locules mainly glabrous or rarely with white, minute, simple hairs or few-celled, stellate hairs. *Ovules* erect, 4–12 per loculus. *Style* simple, filiform, glabrous or with sessile white stellate hairs on the basal quarter. *Stigma* dry, tubular. *Fruit* a loculicidally

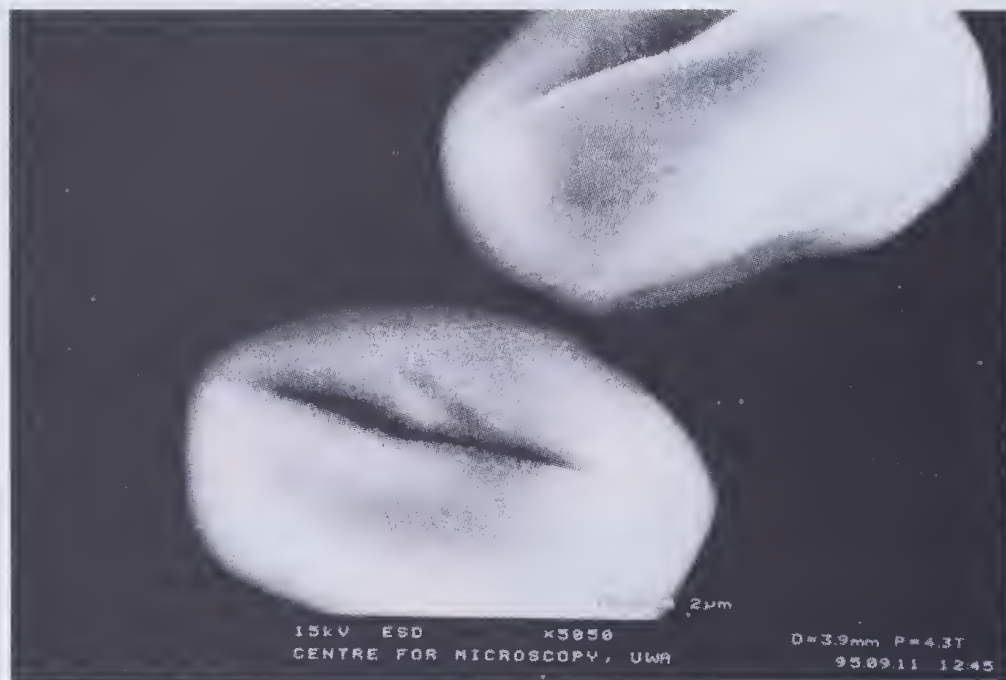


Figure 5. Reticulate exotesta of white, prolate pollen of *Lysiosepalum involucreatum* (voucher *L. involucreatum*, Kings Park Botanic Garden seed 196/1986, Magenta Rd, S of Newdegate).

dehiscent capsule, outer surface with persistent, brittle, stellate hairs. *Seed* dark brown, ellipsoid, smooth with scattered, simple and sessile stellate hairs, aril cream, cap-like, with two longer lobes extending up the hilar surface to half the seed length, testa bitegmic, endosperm present. *Embryo* straight.

Distribution. *Lysiosepalum* is widespread in the wheatbelt from Yuna (north-east of Geraldton) to Ravensthorpe (Figure 6). Plants occur in open woodland or shrubland, often at tree bases, in lateritic gravel, yellow-brown sand, sandy clay or sandy loam.

Notes. Chapman (1991) observed that Bentham (1863) misspelt the name *Lysiosepalum* as *Lyriosepalum* in the index to "Flora Australiensis", but had the correct spelling in the text, and Schumann misspelt the name as *Lysiopetalum* (Schumann 1895).

Lysiosepalum is most similar to Lasiopetaleae genera *Thomasia* Gay, *Lasiopetalum* Sm. and *Guichenotia* Gay in having terminal, poricidal anther dehiscence rather than dehiscence by extrorse slits as in the three remaining genera of the tribe, *Hannafordia* F. Muell., *Keraudrenia* Gay and *Seringia* Gay. *Lysiosepalum* is, however, unique in Lasiopetaleae in having features that Mueller (1859) considered distinctive when he described the genus. One of these is three epicalyx bracts that are shortly fused at the base and equally spaced to completely enclose the mature bud. Other Lasiopetaleae have one epicalyx bract (*Lasiopetalum*), no epicalyx (*Keraudrenia* and *Seringia*), or three unilateral epicalyx bracts (*Guichenotia*, *Hannafordia*, *Lasiopetalum*, *Thomasia*) that if ovate rather than filiform, cover only the exposed side of the bud rather than completely enclosing the mature bud. The second distinctive feature of the genus is the almost free calyx lobes, compared with other Lasiopetaleae which have longer calyx tubes. Mueller (1859) also described *Lysiosepalum* anthers as being distinct from those of *Lasiopetalum* in not splitting longitudinally from the terminal pores, however, mature anthers of *L. rugosum* and the new species *L. abollatum* do share this character.

Key for species of *Lysiosepalum*

1. Leaves with a peppery scent; blade ovate to broadly ovate, petiole 4–7 mm long. Flowers (4)5-merous, anthers bright red. (Narrogin area) **2. *L. aromaticum***
1. Leaves not scented; blade narrowly ovate to linear-oblong, petiole 0.5–3 mm long. Flowers 6-merous, anthers dark red
 2. Pedicel and abaxial surface of epicalyx bracts with red and/or green, conspicuous, long-stalked, clavate glands c. 0.7 mm long, longer than or same length as stellate hairs. (S of Wongan Hills to E of Katanning) **3. *L. hexandrum***
 2. Pedicel and abaxial surface of epicalyx bracts either without glands or with inconspicuous white glands c. 0.1 mm long, shorter than stellate hairs
 3. Adaxial surface of mature leaf smooth or slightly rugose, margin entire or slightly irregular, strongly recurved. Adaxial surface of epicalyx bract with dense, white tomentum of stellate hairs; abaxial surface orange-tan. (Chiddarcooping to Pallinup River, S of Gnowangerup) **4. *L. involucreatum***
 3. Adaxial surface of mature leaf strongly rugose, margin crisped, moderately recurved. Adaxial surface of epicalyx bract with scattered to medium density, white, stellate hairs; abaxial surface greenish tan, or white with brown-tan spots, rarely all tan
 4. Petiole of mature leaves 1–3 mm long. Young branches and inflorescences with a close tomentum of short, sessile or subsessile, c. 24-armed stellate hairs to 0.3 mm diam, glands absent. Epicalyx bracts acute. (NE of Geraldton to E of Wongan Hills) **5. *L. rugosum***
 4. Petiole of mature leaves 0.5–1 mm long. Young branches and inflorescences with woolly appearance from scattered to medium density, long-stalked, 4–12-armed, stellate hairs 1–3 mm diam., often over short clavate glands. Epicalyx bracts acuminate. (Wongan Hills) **1. *L. abollatum***

1. *Lysiosepalum abollatum* C.F. Wilkins, *sp. nov.*

Species insignis indumento laxo cum pilis magnis (usque ad 3 mm diameter) stellatis ornatis, 4–12 brachiis per pilum; pilis supra pedicellum, pedunculum, et bracteolum exteriorem praecipue grandioribus. Bracteolus abaxialis ad apicem purpureo–ruber ad basim viridis perspicue manifestus.

Typus: Wongan Hills [precise locality withheld], Western Australia, 1 October 1996, C.F. Wilkins, CW 1213 & J. Wege, (*holo:* PERTH (04896491), *iso:* CANB, K, MEL, NSW).

Shrub to 1.5 x 1.5 m, scent absent; young growth and inflorescences (young branches, stipules, petioles, bracts, peduncles and pedicels) with white woolly appearance from large stellate hairs; indumentum of scattered 4–12-armed stellate hairs 1–2.3 mm diam., with a red stalk 0.2–0.6 mm long and arms white with tan–centre, overlying sessile or subsessile, stellate hairs 0.25–1.0 mm diam. and white clavate glands c. 0.1 mm long. *Stipules* usually present, sessile, 0.6–1.5 x 0.6–1.3 mm (c. 4 x 1.5 mm in young growth). *Leaves* erect or spreading; petiole 0.5–1 mm long; blade mid green, discolorous, narrowly ovate, 10–16 x 2–3 mm (c. 35 x 4 mm in young growth), base sub–cordate, apex obtuse, margin crisped and moderately recurved, both surfaces with stalked stellate hairs and white clavate glands but no underlying sessile hairs; abaxial surface with a dense indumentum; adaxial surface strongly rugose, with scattered hairs. *Inflorescence* 40–90 mm long, 4- or 5(8)-flowered; peduncle 10–35 mm long. *Bracts* linear–oblong or spatulate, 5–10 x 0.3–1 mm, margins fringed with

stalked stellate hairs. *Pedicels* 5–12 mm long. *Epicalyx bracts* shortly fused at base to 0.3 mm, ovate, 6.5–9 x 3–6.5 mm, apex acuminate, margins fringed with stalked, stellate hairs; adaxial surface red, with scattered sessile, fine, white, stellate and simple hairs and clavate glands c. 0.1 mm long; abaxial surface green base and purple apex with medium density, long-stalked stellate hairs to 3 mm diam., which protrude from the margins, overlying white clavate glands c. 0.1 mm long. *Flowers* 6-merous. *Calyx lobes* ovate, elliptic or oblong, 6.5–11.5 x 3.2–3.5 mm, apex acute; abaxial surface with sessile and stalked, white stellate hairs c. 0.4 mm diam. and scattered short, clavate glands c. 0.1 mm long, ribs with additional scattered, stalked, white tan-centred, stellate hairs to 1 mm diam. *Petals* usually present, usually horizontal, rarely erect, flat, dark red, 0.8–1.5 x 0.8–1.3 mm. *Androecium* dark red; staminodes absent. *Filaments* free or shortly fused into staminal tube 0.2–0.4 mm long; free portion

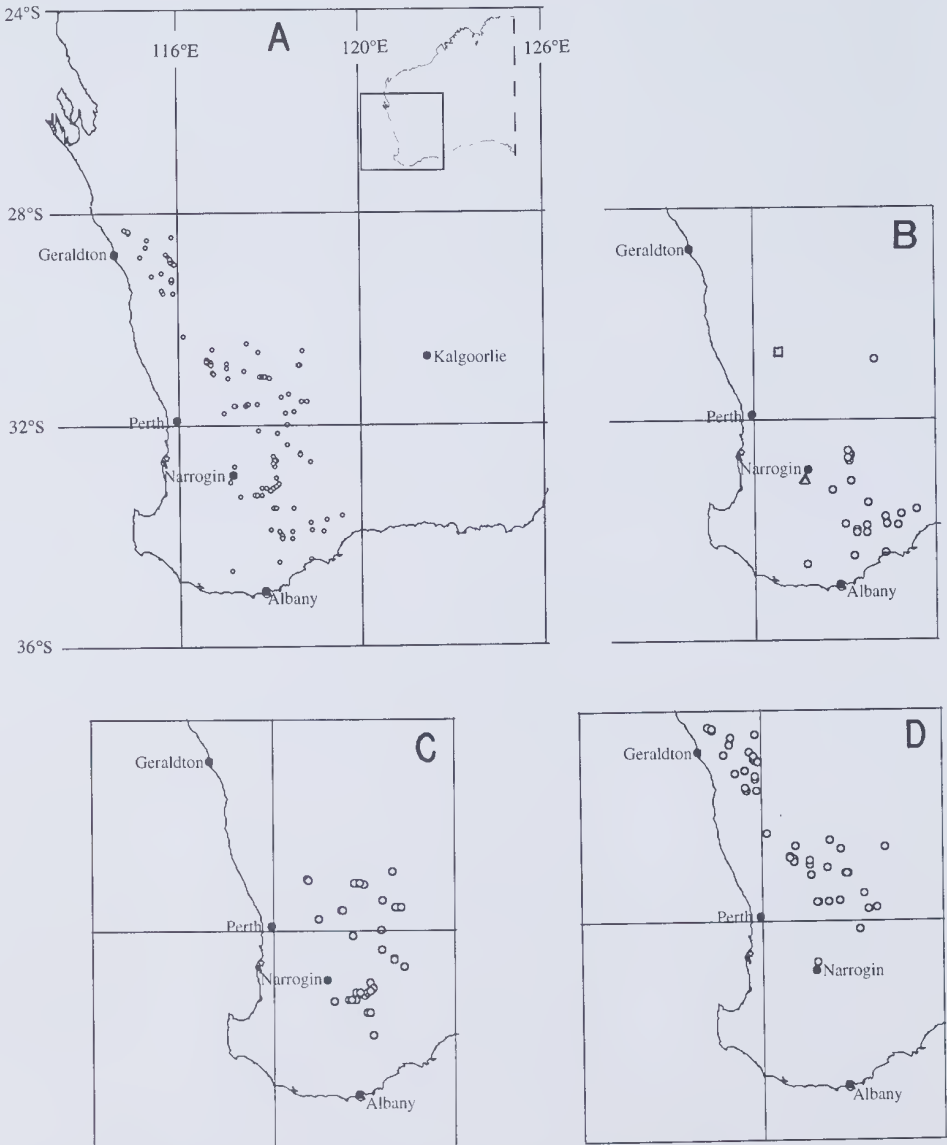


Figure 6. Distribution of *Lysiosepalum* in Western Australia. A – whole genus. B – *L. abollatum* □, *L. aromaticum* △ and *L. involucratum* ○. C – *L. hexandrum*. D – *L. rugosum*.

0.5–0.7 x 0.6 mm. *Anthers* 3–4.8 x 0.8–1 mm; pores becoming extended as longitudinal slits when mature. *Ovary* with arms of the stellate hairs shortly fused at base. *Style* 2.5–3.7 mm long, extending c. 3 mm beyond anthers; base with a dense indumentum of sessile, white, stellate hairs. *Fruit* not observed. (Figure 7)

Selected specimens examined. WESTERN AUSTRALIA [precise locality withheld]: Wongan Hills, 27 Aug. 1976, R. Coveny 7851 & B.R. Maslin (PERTH); Wongan Hills, 11 Sep. 1993, M.J. Fitzgerald

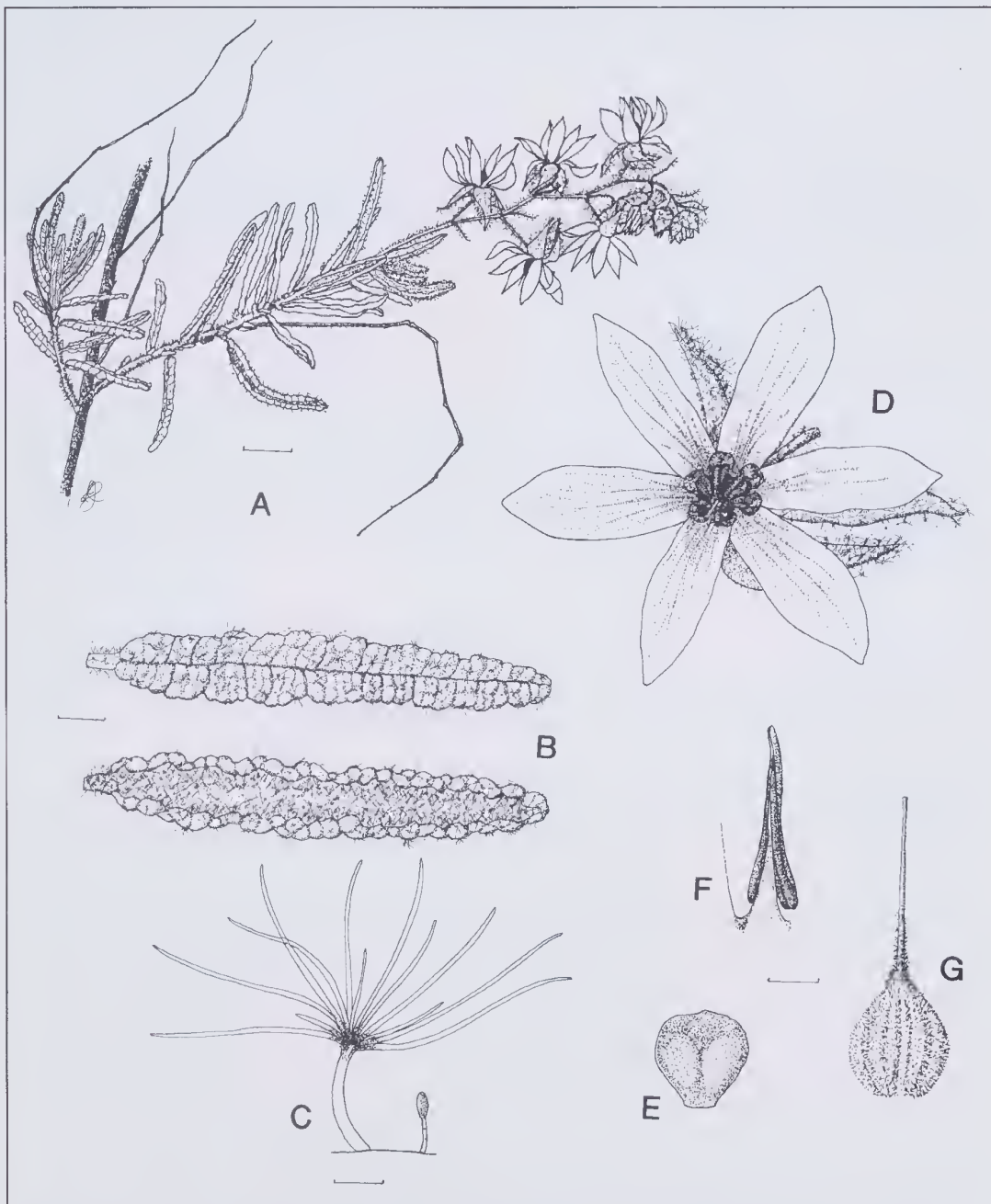


Figure 7. *Lysiosepalum abollatum*. A - habit (bar = 1 cm). B - leaf surfaces (bar = 2.5 mm). C - stellate hair and gland on abaxial surface of bracteole (bar = 0.5 mm). D - flower (bar = 2.5 mm). E - petal. F - anther adaxial view. G - pistil (E, F & G bar = 1 mm). Drawn from K.F. Kenneally 9337.

0001 (PERTH); Wongan Hills, 15 Sep. 1983, *K.F. Kenneally* 8830 (PERTH); Wongan Hills, 3 Sep. 1984, *K.F. Kenneally* 9337 (PERTH).

Distribution. Restricted to one locality in the Wongan Hills range of hills, north of the township of Wongan Hills, Western Australia. (Figure 6B)

Habitat. This species occurs in orange-brown, sandy clay with laterite, in open mallee woodland (to c. 5 m) at base of *Eucalyptus* trees.

Phenology. Flowering time is August to October. Fruit not observed.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority One. There have been four collections in the same approximate area, however, it is not known if they are from the same population. Currently known by the authors from one or two small populations on a private reserve, bordered by cleared farmland. Further survey urgently required with probable need for recognition as Declared Rare Flora.

Etymology. *Abolla* (Latin) translates as "a robe of thick woollen stuff worn by soldiers and philosophers", and alludes in this species to its woolly appearance derived from the loose covering of long-stalked, large, stellate hairs.

Affinities. This species is similar to *L. rugosum* in having a long inflorescence with up to eight flowers and leaves with rugose surfaces and recurved margins. It differs in having short petioles 0.5–1 mm long, rather than 1–3 mm long, epicalyx bracts with an acuminate rather than acute apex and a woolly appearance from long-stalked, large, stellate hairs rather than a close tomentum of sessile, small, stellate hairs.

2. *Lysiosepalum aromaticum* C.F. Wilkins, *sp. nov.*

Species fortiter amaro odora, foliis late ovatis vel ovatis petiolis longis, stipulis petiolatis, floribus 4 vel 5 meris, antheris rutilis a congeneribus diversa.

Typus: State Forest 52, Highbury block, Eastern Boundary, Western Australia, 23 November 1998, G. Warren 23, C. Taylor, P. Rose. (*holo:* PERTH 05315700; *iso:* K).

Shrub to 75 x 100 cm with strong aromatic scent; all plant surfaces except adaxial epicalyx bract surface, calyx, androecium and gynoecium with dense, multicelled, long-stalked, red-tipped clavate glands to 0.7 mm long, overlying dense, sessile, 10–12-armed, white stellate hairs to 0.5 mm diam.; young growth with tan hairs. *Stipules* always present, stipitate, 0.5–1 mm long, blade 2–6 x 2–7 mm (seedling young growth blade c. 10 x 13 mm, petiole c. 4 mm long). *Leaves* reflexed. *Petioles* 4–7 mm long (c. 15 mm in seedling young growth). *Blades* grey-green, scarcely discoloured, ovate to broadly ovate, 16–22 x 10–12 mm (seedling young growth c. 50 x 30 mm); blade strongly rugose, base cordate apex acute or rounded, margin crisped and slightly recurved. *Inflorescence* 25–50 mm long, 2–4(5)-flowered; peduncle 9–20 mm long. *Bracts* spatulate, 3–7.5 x 0.8–1.3 mm; adaxial surface with medium density clavate glands; abaxial surface with dense stellate hairs and glands. *Pedicels* 5–6 mm long. *Epicalyx bracts* very shortly fused at base for 0.3–0.5 mm, broadly ovate, 6.5–8.5 x 4.5–6.5 mm, apex acute; adaxial surface with medium density, sessile, white, fine stellate hairs c. 0.2 mm diam. and simple hairs. *Flowers* 4- or 5-merous. *Calyx* lobes elliptic, 5.8–6.5 x 2–3.5 mm, apex acute; abaxial surface ribs and blade with scattered, sessile, white, 2–5-celled stellate hairs to 0.5 mm diam. *Petals*

always present, erect, flat, bright red, c. 1 x 0.8 mm. *Androecium* bright red; staminodes c. 0.6 x 0.2 mm. *Filaments* free, c. 0.2 x 0.2 mm. *Anthers* 3–4 x 1.3 mm; pores not becoming extended at maturity. *Ovary* with cells of the stellate hairs shortly fused at base. *Style* short, c. 1.6 mm long, stigma level with apex of anthers; style base with scattered, sessile, white, stellate hairs. *Fruit* ovoid, c. 5.5 x 5.5 mm. *Seed* c. 2.3 x 1.3 mm. (Figure 8)

Other specimens examined. WESTERN AUSTRALIA: State Forest 52, Highbury block, Eastern Boundary track off Forestry Rd, S of Narrogin, C.F. & J. Wilkins 1418, G. Warren, C. Taylor, P. Rose, 23 May 1999 (PERTH).

Distribution. Restricted to one population south of Narrogin, Western Australia. (Figure 6B)

Habitat. This population occurs in orange-brown sandy loam at the base and mid slope of a granite rock outcrop. It is mainly an understorey shrub in *Allocasuarina huegellii* woodland with scattered *Eucalyptus calophylla*, *Astroloma drummondii*, *Patersonia* and *Stypandra glauca*, however, there are ungrazed *L. aromaticum* plants, in open conditions in an adjacent, grazed paddock.

Phenology. Flowering time is October to November.

Conservation status. CALM Conservation Codes for Western Australian Flora: Priority Two. Known from a single population of c. 200 plants in a state forest. Further survey is urgently required as this taxon probably needs to be categorized as Declared Rare Flora.

Etymology. The specific epithet is taken from the Latin – *aromaticus* meaning aromatic, for the shrub's spicy odour.

Affinities. This species is similar to *L. hexandrum* in having long-stalked, red, clavate glands on inflorescences, however, *L. aromaticum* also has abundant glands on stems and leaves. It resembles *L. abollatum* and *L. rugosum* in having strongly rugose leaves, however, this species is distinct in the genus by having broadly ovate to ovate, rather than narrowly ovate to linear, leaves, flowers that are (4)5-merous, rather than consistently 6-merous, and bright red, rather than dark red, anthers.

3. *Lysiosepalum hexandrum* (S. Moore) S. Moore (in Sargent 1923: 287). – *Thomasia hexandra* S. Moore (Moore 1921: 245–246). *Type citation:* Emu Hill (about 50 miles east of Beverley), by State School; Hb. Sargent 782. *Type:* Emu Hill, about 50 miles [80 km] east of Beverley, Western Australia, O.H. Sargent 782 (*holo:* BM).

Shrub to 90 x 90 cm, scent absent; young branches with a tomentum of c. 24-armed, tan or white with tan-centred stellate hairs 0.2–0.4 mm diam., mainly mixed with scattered, stalked, red clavate glands c. 0.3 mm long. *Stipules* always present, sessile, 0.5–1 x 1–4 mm. *Leaves* erect. *Petioles* 0.6–1.5 mm long. *Blades* grey-green, discolorous, linear-oblong or narrowly elliptic, 3–17 x 1.3–2 mm, base attenuate, apex obtuse, margin either slightly irregular or entire, strongly recurved; adaxial surface faintly rugose or smooth, with medium density, sessile, fine, white stellate hairs c. 0.4 mm diam., often with scattered short-stalked clavate glands c. 0.1 mm long; abaxial surface usually with only midrib showing, with dense tan, stellate hairs, often with scattered glands c. 0.1 mm long. *Inflorescence* 35–70 mm long, (3)5(8)-flowered; peduncle 10–30 mm long, with long-stalked, red clavate glands to 0.7 mm long, overlying medium density, sessile, white stellate hairs c. 0.4 mm diam. *Bracts* spatulate, 2–7 x 0.5–1.3 mm, both surfaces with medium to dense stellate hairs and scattered glands to 0.5 mm long. *Pedicels* 4–7.5 mm long, with the same indumentum as the peduncle.

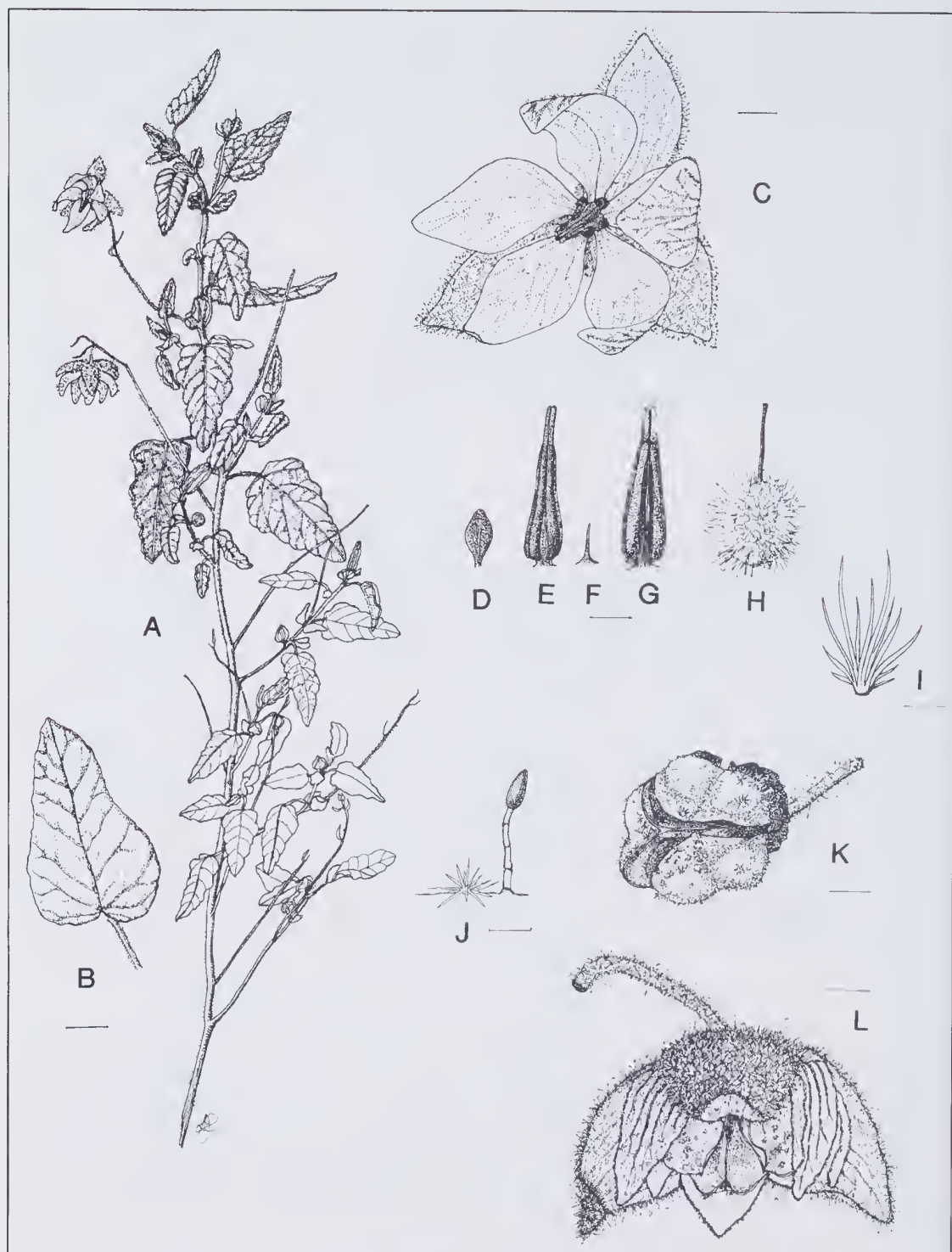


Figure 8. *Lysiosepalum aromaticum*. A - habit, B - juvenile leaf (bar = 1 cm). C - flower (bar = 2.5 mm). D - petal. E - anther abaxial view. F - staminode. G - anther adaxial view. H - pistil (D-H bar = 1 mm). I - ovary hair (bar = 0.05 mm). J - glandular hair and stellate hair on abaxial surface of bracteole (bar = 0.2 mm). K - fruit with sepals removed. L - fruit within sepals and bracteoles (K & L bar = 8 mm). Drawn from G. Warren 23 (A-J) and C.F. Wilkins 1418 (K,L).

Epicalyx bracts shortly fused at base to 0.5 mm, ovate, 5.5–10 x 3–6 mm, apex acute; adaxial surface white, with medium to dense stellate hairs and scattered glands c. 0.1 mm long; abaxial surface greenish-tan when mature, with dense long-stalked, red and/or green, clavate glands 0.5–0.7 mm long, overlying white with tan-centred or yellow stellate hairs to 0.6 mm diam. *Flowers* 6-merous. *Calyx lobes* narrowly elliptic, narrowly ovate or narrowly obovate, 6–8.5 x 2–4.5 mm, apex rounded; abaxial surface with scattered stellate hairs to 0.3 mm diam., ribs with dense, white stellate hairs, c. 0.5 mm diam. and occasional long red glands. *Petals* usually absent, when present alignment and curvature unknown, dark red, c. 1.5 x 0.8 mm. *Androecium* dark red; staminodes absent or minute, narrowly triangular, c. 0.1 mm long. *Filaments* free or shortly fused into staminal tube 0.3–1.4 mm long; free portion 0.3–1.4 mm x 0.8 mm. *Anthers* 2.8–4 x 0.8–1 mm; pores not becoming extended at maturity. *Ovary* with cells of the stellate hairs fused for up to half of hair length. *Style* 2–2.8 mm long, extending c. 1 mm beyond anthers; base with few to medium density, stellate hairs. *Fruit* 3–5 x 2.5–4 mm. *Seed* 1.8–2 x c. 1 mm. (Figure 9)

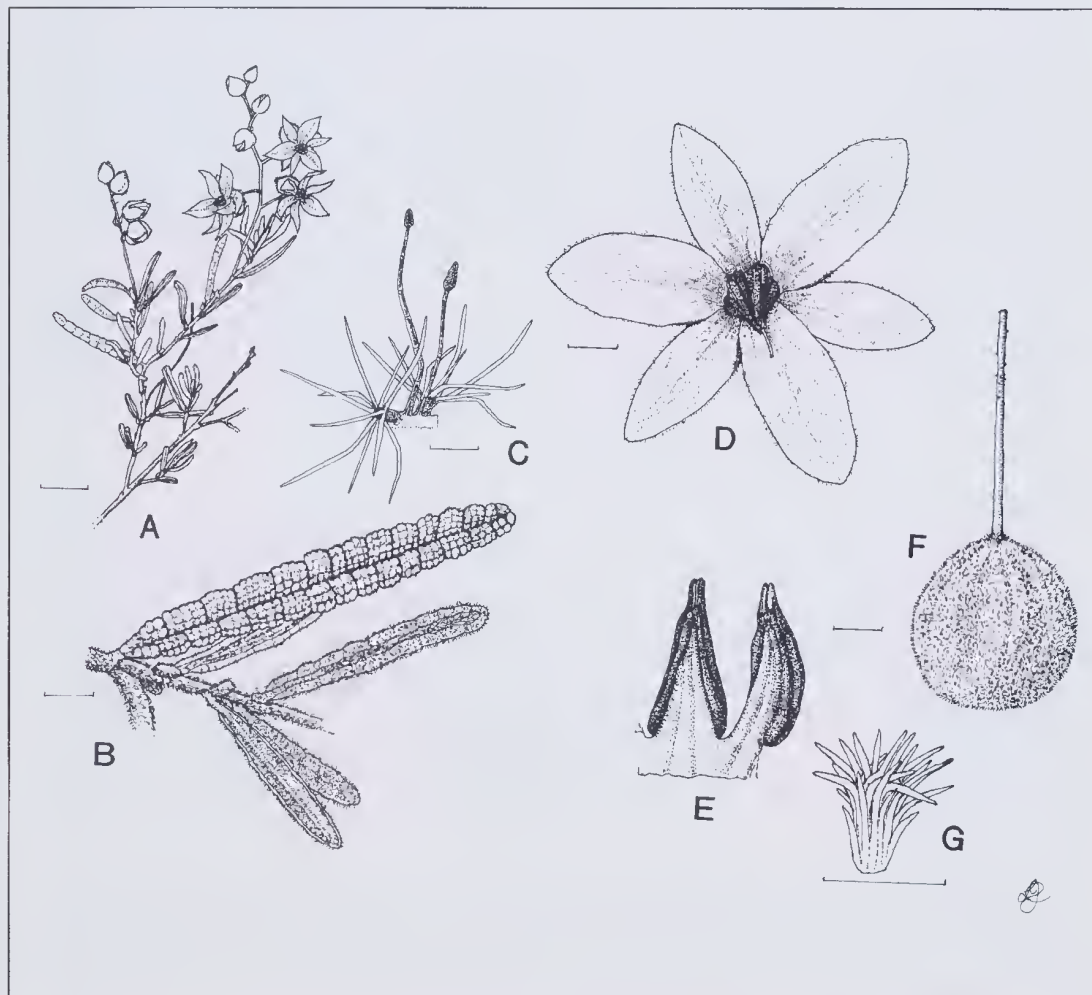


Figure 9. *Lysiosepalum hexandrum*. A – habit (scale bar = 1 cm). B – juvenile leaf with rugose surface and mature leaves with smooth surfaces. C – glandular and stellate hairs on abaxial surface of bracteole (bar = 0.1 mm). D – flower (B & D bar = 2 mm). E – adaxial surface of androecium. F – pistil (E & F bar = 0.5 mm). G – ovary hair (bar = 0.1 mm). Drawn from K. Shepherd 68 and C.F. Wilkins 167.

Selected specimens examined. WESTERN AUSTRALIA: 115 mile peg on Great Eastern Hwy, 13 Sep. 1962, *T.E.H. Aplin* 1986 (AD); S of Narembreen, 8 Aug. 1963, *A.M. Ashby* 162 (AD); 2 km by road E of Pederah, 17 Oct. 1977, *W.H. Barker* 2467 (AD); 5.5 km E of Tammin, 11 Sep. 1976, *R. Coveny* 8318 & *B. Habersley* (PERTH); 26 km due SW of Bodallin, 16 Sep. 1982, *R.J. Cranfield* 2349 (PERTH); Holden Rd, Shire of Lake Grace, 24 Oct. 1986, *E.J. Croxford* 5346 (PERTH); 6 km W of Burracoppin, 23 Aug. 1995, *R. Davies* 85 (PERTH); Kukerin, Oct. 1913, *M. Koch* 2185 (NSW, MEL, PERTH); 25 km NE of Dumbleyung, 20 Sep. 1964, *R.H. Kuchel* 2007 (AD); Tammin, Sep.–Nov. 1909, *J.H. Maiden s.n.* (NSW); 4 miles [6 km] W of Nyabing, 14 Sep. 1961, *R.D. Royce* 6704, (PERTH); 9.8 km E of Bendering on Reserve Rd, 8 Sep. 1994, *K.A. Shepherd* KS 57, *J.A. Chappill*, *J.A. Wege* (PERTH, UWA); 500 m N of Jilikin Flat Rd on Bueffner Rd, 11 Oct. 1996, *J.A. Weges s.n.* (PERTH, UWA); 50 km NNW of Merredin, 31 Oct. 1974, *D.J.E. Whibley* 4746 (AD, PERTH); Konongorring new school site, Williams–Wongan Hills road, 5 Sep. 1992, *C.F. Wilkins* CW 167–168 (PERTH, UWA); Boolanelling Nature Reserve, Pannell Williams Rd, 9.5 km N of Quairading–Bilbarrin road, 25 Nov. 1994, *C.F. Wilkins* CW 736 (PERTH, UWA); Tarin Rock, 9 Nov. 1968, *J.W. Wrigley s.n.* (MEL).

Distribution. This species ranges from Konongorring to Nyabing, in the south-west of Western Australia. (Figure 6C)

Habitat. This species is found as understorey in *Eucalyptus* open woodland, or rarely heath, in yellow or brown clayey sand, usually with laterite.

Phenology. Flowering time is August to October. Fruiting October to December.

Conservation status. This species is well collected and mainly recorded as abundant in the area of collection. No special status is required.

Etymology. Named due to the hexandrous flowers.

Affinities. This species has the distinct specific features described by Moore of long red glandular hairs on the epicalyx, epicalyx that are greenish rather than orange-tan in colour and mainly narrower than in *L. involucratum*, and petals that are usually absent and if present then fewer than six per flower whereas *L. involucratum* usually has six petals. Similarities to *L. involucratum* are leaves with smooth or slightly rugose surfaces and strongly recurved leaf margins.

Notes. Two specimens from Chiddarcooping and Narembreen are anomalous as the long red glands are rare or absent rather than forming a dense covering as in other specimens examined. These have been determined as *L. hexandrum* as they are apetalous, with greenish-tan abaxial epicalyx bract surfaces rather than tan and without the dense, white tomentum found on the epicalyx bract adaxial surface of *L. involucratum*.

4. *Lysiosepalum involucratum* (Turcz.) Druce (Druce 1917: 634). – *Thomasia involucrata* Turcz. (Turczaninov 1852: 143). *Type citation:* N. Holl. Drum. V. n. 255. *Type:* south-west of Western Australia, *Drummond coll.* 5, n. 255 (*holo:* KW n.v. photograph PERTH 05070341; *iso:* BM, K, MEL 724048, PERTH 01625608, W).

Lysiosepalum barryanum Muell. (Mueller 1859: 143). *Type citation:* In planitiebus ad flumen Phillips Mx. *Type:* Phillips River, Western Australia, *Maxwell (holo:* MEL 724049)

Illustration. Grieve (1998: 653).

Shrub to 1.2 m x 1.2 m, scent absent; young branches with close tomentum of sessile or short-stalked, up to 24-celled, white with brown-centred, stellate hairs 0.2–0.6 mm diam., glands absent. *Stipules* present at most leaf nodes of each stem but absent at others, sessile, 0.6–1.3 x 0.5–1.3 mm (4.5 x 2.5 mm on young growth). *Leaves* erect. *Petioles* 0.5–1.0 mm long. *Blades* grey-green, discolorous, linear-oblong, 8–15 (20) x 1–2 mm (30–45 x 5–10 mm on young growth), base attenuate, apex obtuse, margin entire, strongly recurved; adaxial surface smooth or faintly rugose with a velvety appearance from dense, sessile, white with pale tan centred, stellate hairs 0.2–0.7 mm diam., occasionally with concealed clavate glands to 0.1 mm long; abaxial surface usually only the midrib showing, with dense sessile and scattered red-stalked stellate hairs. *Inflorescence* 35–50 mm long, 2 or 3(4)-flowered; peduncle 12–20 mm long, with a medium density indumentum of stellate hairs to 1.0 mm diam. with red-stalk to 0.7 mm long and white with brown-centre, overlying smaller, sessile, white stellate hairs. *Bracts* linear, narrowly ovate or narrowly obovate, 2.5–6.5 x 0.3–1.5 mm; adaxial surface with glands c. 0.1 mm long and sessile white stellate hairs; abaxial surface and margin with dense stalked stellate hairs. *Pedicels* 5–7 mm long, with a similar diameter and indumentum to peduncle. *Flowers* 6-merous. *Epicalyx bracts* fused at the base to 1 mm, broadly ovate, 5–9 x 3–7 mm, apex acute; adaxial surface with a dense indumentum of short-stalked and sessile, white, fine, stellate hairs and concealed clavate glands c. 0.1 mm long; abaxial surface concealed by a tomentum of long red-stalked, orange-tan stellate hairs to 1.5 mm diam., which protrude from the margins, overlying short glands 0.1 mm long and white stellate hairs to 0.3 mm diam. *Calyx lobes* narrowly ovate, 6.5–10 x 2.5–5 mm, apex rounded; abaxial surface with scattered, sessile, white stellate hairs to 0.2 mm diam. and ribs with additional scattered stalked, white with tan-centred, stellate hairs to 0.5 mm diam. and rarely short clavate glands on ribs and lamina. *Petals* rarely absent, erect, dark red, cup-shaped, 1.2–2.1 x 1–1.4 mm. *Androecium* dark red; staminodes 3–6 per flower, narrowly triangular, c. 0.1–1.6 mm long. *Filaments* free or shortly fused into staminal tube 0.5–1 mm long; free portion c. 0.5 x 0.6 mm or absent. *Anthers* 3.3–4.5 x 0.8–1 mm; pores not becoming extended at maturity. *Ovary* with cells of the stellate hairs fused for up to 3/4 of hair length. *Style* 2.5–4 mm long, extending up to 4 mm beyond anthers; base with dense stellate hairs. *Fruit* c. 5 x 4.5 mm. *Seeds* 1.2–1.8 x 0.8–1 mm. (Figure 10)

Selected specimens examined. WESTERN AUSTRALIA: Kulin, Sep. 1947, A. Ashby 118 (AD, PERTH); Jerramungup, 18 Oct. 1964, J.S. Beard 3641 (PERTH); 6 km NE of S Kulin, 25 Oct. 1983, R.J. Cranfield 4758 (PERTH); Kukerin–Tarin Rock road, 26 Oct. 1981, E.J. Croxford 1608 (PERTH); Pingrup road, 18 Oct. 1982, E.J. Croxford 2010 (PERTH); Cowcowing, Oct. 1904, M. Koch 1180 p.p., (P, PERTH); near Ongerup, 24 Oct. 1972, E.C. Nelson ANU 16797, (CANB); 9 km WNW of Bivouac Rock, Fitzgerald River National Park, 4 Nov. 1973, K. Newbey 3965 (PERTH); Millers Point above Beaufort Inlet, Pallinup River Mouth, 17 Nov. 1992, C.J. Robinson 1034 (PERTH); Gnowangerup, 22 Oct. 1920, O.H. Sargent 862 (PERTH); 6 km S of Toompup homestead, 7 Oct. 1979, Toelken 6471, (AD, PERTH); head of Fitzgerald River, 65 miles [.. km] W of Ravensthorpe, 3 Sep. 1947, J.H. Willis (MEL); 6 miles [10 km] SE of Borden, 10 Sep. 1963, J.H. Willis (MEL); 11.6 km S from Ravensthorpe–Jerramungup road along Quiss road, 28 Sep. 1997, C.F. Wilkins CW1386, J.A. Wege, R. Butcher (PERTH, UWA).

Distribution. This species extends from Cowcowing to Twertup Creek in the Fitzgerald River National Park. (Figure 6B)

Habitat. This species occurs in brown sandy clay or loam, mainly with laterite, generally as an understorey shrub in *Eucalyptus* or *Allocasuarina* open woodland or shrubland.

Phenology. Flowering time is July to November, fruiting November to January.

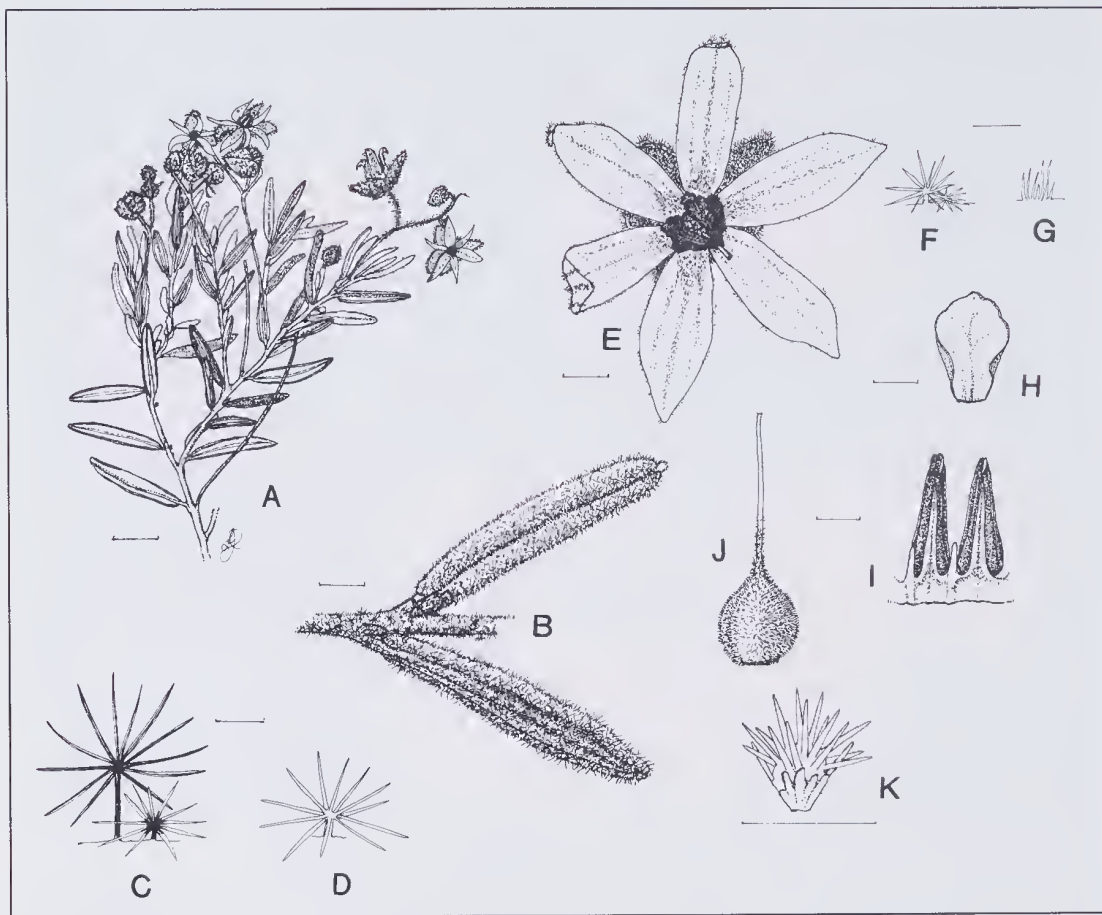


Figure 10. *Lysiosepalum involucratum*. A – habit (scale bar (bar) = 1 cm). B – mature leaves (bar = 2 mm). C – stellate hairs on outer surface of bracteole. D – stellate hair on inner surface of bracteole (C & D bar = 0.1 mm). E – flower (bar = 2 mm). F – stellate hairs on outer surface of calyx. G – simple hairs on inner surface of calyx. H – petal (bar = 0.5 mm). I – adaxial surface of androecium. J – pistil (I & J bar = 1 mm). K – ovary hair (bar = 0.1 mm). Drawn from K. Shepherd 51 and C.F. Wilkins 1111.

Chromosome number. $n=10$ (Figure 3).

Conservation status. This species has been poorly collected and mainly recorded as occasional or 1–3 plants, rarely frequent in the area. Conservation status deserves review after separation of numerous *L. hexandrum* from *L. involucratum* collections.

Etymology. An involucre is a large bract or whorl of bracts; the epithet *involucratum* presumably refers to the whorl of large epicalyx bracts covering the buds in this genus.

Affinities. This species is similar to *L. hexandrum* in having entire, rather than wrinkled leaf margins but differs in having the pedicels and epicalyx with an indumentum of long red-stalked stellate hairs instead of long red glandular hairs over short white stellate hairs, by having the epicalyx orange tan instead of greenish tan and petals that are rarely absent rather than rarely present.

5. *Lysiosepalum rugosum* Benth. (Bentham 1863: 267). *Type citation*: W. Australia. Swan River, Drummond. *Type*: south-west of Western Australia, *J. Drummond* (lecto: K, here designated; *isolecto*: MEL)

Illustrations. Grieve (1998: 653); Elliot & Jones (1990: 256).

Shrub to 1 m x 1 m, scent absent; young branches with close tomentum of sub-sessile or sessile, up to 24-celled, white with tan or brown-centred, stellate hairs c. 0.3 mm diam., glands absent. *Stipules* always present, sessile, c. 0.8 x 0.8 mm. *Leaves* mainly spreading or reflexed, only apical leaflets erect. *Petioles* 1–4 mm long. *Blades* grey, discolorous, narrowly ovate, 4–20 x 0.8–2 mm (young growth leaves c. 35 x 7 mm, stipules c. 3 x 5 mm), base cordate or sub-cordate, apex obtuse, margin crisped and scarcely recurved; adaxial surface strongly rugose with dense, sessile, white stellate hairs c. 0.4 mm diam. that become scattered or glabrous with maturity, glands absent, apical leaves white with brown spotted appearance; abaxial surface with a dense tomentum of yellow-tan stellate hairs to 0.5 mm diam., rib tan, (seedling and young plant leaves may have greenish white, not yellow abaxial surfaces) glands absent. *Inflorescence* 25–110 mm long, (2)4–6(8)-flowered; peduncle 9–25(50) mm long, with close tomentum of spotted appearance from short-stalked or sessile, white with tan- or brown-centred stellate hairs to 0.2 mm diam. *Pedicels* 5.5–7(11) mm long, with similar indumentum to the peduncle. *Bracts* linear or spatulate, 1.5–6 x 0.3–0.5 mm, adaxial and abaxial surfaces with dense tomentum of stellate hairs, glands absent. *Epicalyx bracts* scarcely fused at the base to 0.3 mm, ovate, 4–8.5 x 2.8–5 mm, apex acute; adaxial surface with scattered to medium density, sessile or subsessile, white, fine, stellate hairs; abaxial surface a close tomentum of stellate hairs, c. 0.4 mm diam., overall appearance either completely spotted from white hairs with brown or tan centres, or tan epicalyx bract base and apex spotted, rarely all tan. *Flowers* 6-merous. *Calyx lobes* ovate, elliptic or obovate, 5–10 x 2–6 mm, apex rounded or sub-acute; abaxial surface with sessile, white, fine, stellate hairs c. 0.25 mm diam., glands absent, ribs with additional medium density, short-stalked, stellate hairs to 0.4 mm diam. *Petals* erect, flat, dark red, 0.8–1.2 x 0.8–1 mm, or absent. *Androecium* dark red; staminodes absent or minute, triangular, c. 0.1 mm long. *Filaments* free or very shortly connate into staminal tube, 0.1–0.3 mm long; free portion 0.1–1 x 0.3 mm. *Anthers* 2–3.5 x 0.8–1 mm; pores becoming extended as longitudinal slits when mature. *Ovary* with stellate hair cells shortly fused at the base. *Style* 2–4 mm long, extending 0.7–1.3 mm beyond anthers; base glabrous or with few stellate hairs. *Fruit* c. 4 x 3 mm. *Seed* 1.5–1.8 x 0.9–1 mm. (Figure 11)

Selected specimens examined. WESTERN AUSTRALIA: near Indarra, c. 66 km E of Geraldton, 30 Aug. 1963, *A.M. Ashby* 256, (AD); Rockwell c. 55 km NE of Geraldton, 12 Aug. 1967, *A.M. Ashby* 2215, (AD, PERTH); 58 km SE of Mullewa on road to Morowa, 15 Sep. 1985, *B.J. Conn* 2156, (MEL, NSW, PERTH); Ballidu, date unknown, *M. Davis* 11011, (AD); Cowcowing, Sep. 1904, *M. Koch* 1180 p.p., (P, NSW, MEL); 2.4 km NE of Canna Siding on Canna North East Rd, c. 40 km NNW of Morawa, 27 July 1996, *B.J. Lepschi* BJL 2730 & *T.R. Lally* (PERTH); 45 km NE of Cadoux, 20 Oct. 1990, *F.H. & M.P. Mollemans* 3476 (AD); Wongan Hills, 3 Oct. 1903, *A. Morrison* n.s., (BRI, PERTH); 1 mile [1.6 km] W of Moonijin, 23 Aug. 1965, *K. Newbey* 1994 (PERTH); Butters Boundary Rd, Northern end, Narembeen North, 7 Oct. 1986, *P.M. Olde* 822 (NSW); N of Canna, beside railway line, 15 Oct. 1986, *P.M. Olde* 890 (NSW); 7 miles [12 km] from Tardun towards Morowa, 1 Oct. 1962, *M.E. Phillips* s.n. (CBG); near Manmanning, 11 Sep. 1982, *B.H. Smith* 100, (MEL); 21.3 km W of Tammin, 24 Nov. 1994, *C.F. Wilkins* CW 732 (PERTH); 8.6 km W of Three Springs, 18 Aug. 1995, *C.F. Wilkins* CW 1013 (PERTH, UWA); 8 km E of Trayning, 22 Nov. 1995, *C.F. & S. Wilkins* CW 1149, *P. Dale & R. Orifici* (PERTH, UWA); 34 km NNE of Corrigin, 21 July 1984, *P.G. Wilson* 11924 (PERTH).

Distribution. This species extends from Rockwell (north-east of Geraldton) to Manmanning, Western Australia. (Figure 6D)

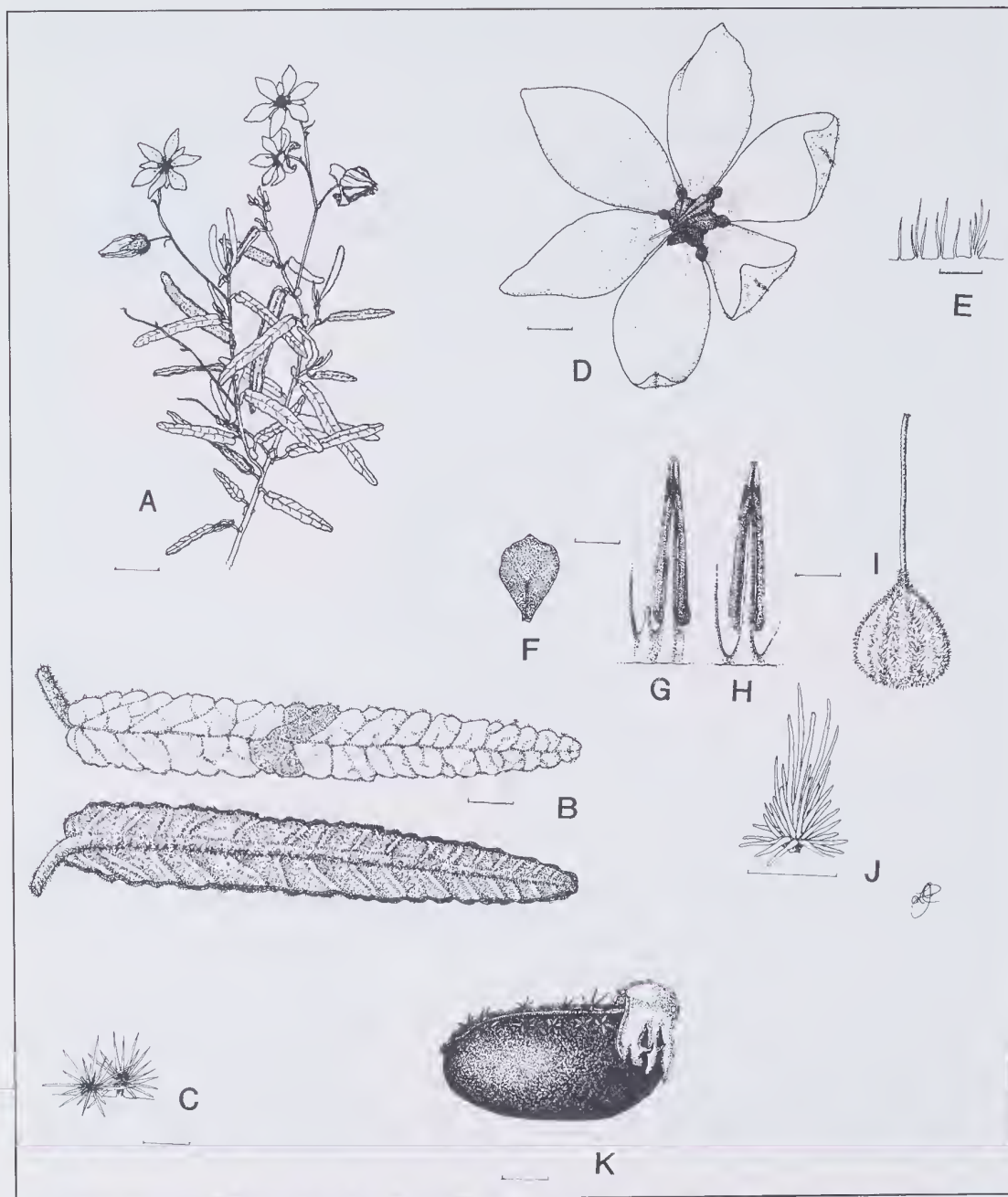


Figure 11. *Lysiosepalum rugosum*. A - habit (scale bar = 1 cm). B - leaf adaxial and abaxial surfaces (bar = 2.5 mm). C - bracteole abaxial surface stellate hairs (bar = 0.25 mm). D - flower (bar = 2.5 mm). E - hairs on adaxial surface of calyx (bar = 0.6 mm). F - petal. G - anther with staminode and staminal tube, adaxial view. H - anther with free filaments, adaxial view. I - pistil (F-I bar = 1 mm). J - brittle hair of ovary (bar = 0.1 mm). K - seed with aril (bar = 0.3 mm). Drawn from C.F. Wilkins 276.

Habitat. This species occurs in red-brown clay or loam with laterite, as an understorey shrub in open shrubland or open woodland.

Phenology. Flowering time is July to October. Fruiting period is October to February.

Conservation status. This species is widely distributed in remnant vegetation in wheatbelt areas and no special conservation status is recommended. Collections are, however, mainly recorded as populations of one plant or occasional, rarely as frequent in the area.

Erymology. The epithet – *rugosum* refers to the rugose “much wrinkled leaves”. A common name is Wrinkle-leaf *Lysiosepalum* (Grieve 1998).

Typification. The K material, comprising five moderately large specimens mounted on the same sheet and all apparently from the same collection, has been chosen as the lectotype. A single much smaller specimen at MEL, annotated as having been seen by Bentham, appears to be an isolectotype.

Affinities. This species resembles *L. abollatum* in having strongly rugose, narrowly ovate leaves but differs in having a close tomentum of small, sessile, stellate hairs rather than a woolly covering of long-stalked, large hairs.

Notes. The abaxial epicalyx bract surface on the type specimen has a short-stalked dense tomentum of stellate hairs with a spotted appearance from dark brown-centred hairs. Some specimens, however, have a tan-spotted or rarely overall tan appearance. These tan specimens are differentiated from *L. involucreatum* by having leaves with long petioles and adaxial surfaces that are rugose not smooth.

Close affinity to *Thomasia* is suggested by a putative cross-generic hybrid *T. formosa* Paust (K.A. Shepherd pers. comm.). *Thomasia formosa* has features of both *Lysiosepalum rugosum* and *T. macrocalyx* Steud., resembling the former in its coriaceous narrow leaves, white stellate-hairy ovary and elongated anthers, and the latter in its unilateral bracteoles, long calyx tube and broader calyx lobes. It is intermediate between the two putative parent species in having some flowers 5-merous like those of *T. macrocalyx* and others 6-merous like those of *L. rugosum*. All three taxa coexist at a Three Springs locality.

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Leiocarpa, a new Australian genus of the Asteraceae tribe Gnaphalieae

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Abstract

Paul G. Wilson, *Leiocarpa*, a new Australian genus of the Asteraceae tribe Gnaphalieae. *Nuytsia* 13(3): 595–605 (2001). A new genus *Leiocarpa* Paul G. Wilson (Gnaphalieae: Asteraceae) is described; it is circumscribed to include the species that have been placed in *Ixiolaena* Benth., other than the type, two of the species placed in *Leptorhynchus* Less., and two species currently in *Chrysocephalum* Walp. The characters that distinguish *Ixiolaena*, *Leiocarpa*, *Leptorhynchus*, and *Chrysocephalum* are discussed. The ten species recognized in the new genus are as follows: *L. brevicompta* (F. Muell.) Paul G. Wilson, *L. gatesii* (H.B. Will.) Paul G. Wilson, *L. leptolepis* (DC.) Paul G. Wilson, *L. panaetioides* (DC.) Paul G. Wilson, *L. pluriseta* (Haegi) Paul G. Wilson, *L. semicalva* (F. Muell.) Paul G. Wilson, *L. serpens* (Everett) Paul G. Wilson, *L. supina* (F. Muell.) Paul G. Wilson, and *L. tomentosa* (Sond.) Paul G. Wilson. One new subspecies is described: *L. semicalva* subsp. *tenuifolia* Paul G. Wilson, and one new subspecific combination, *Leiocarpa semicalva* subsp. *vinacea* (Haegi) Paul G. Wilson, is made. Lectotypes are chosen for *L. brevicompta*, *L. tomentosa*, *L. semicalva*, and *L. supina*.

Introduction

When investigating the anatomy of cypselas in Australian members of the tribe Gnaphalieae (Asteraceae), Short *et al.* (1989) noted that the cypselas of *Ixiolaena viscosa* Benth., the type of *Ixiolaena* Benth., was radically different from the cypselas of other species that had been placed in the genus. Subsequently Anderberg (1991), in a taxonomic treatment that covered the whole tribe, indicated that *Ixiolaena* was heterogeneous and that the type species differed in many characters from the other species in the genus (although he did not state in what manner it differed). In the process of preparing an account of *Ixiolaena* for the "Flora of Australia" it has become possible to confirm the comments of both Short *et al.* and of Anderberg, and it is apparent that all *Ixiolaena* species except for the type need to be reassigned.

The Australian genera in the Gnaphalieae *sensu* Anderberg (1991) were investigated to ascertain the correct placement of the non-typical species of *Ixiolaena*. In this regard the anatomy and indumentum of the cypselas was of particular interest. It was apparent that one species currently placed in *Chrysocephalum* Walp. and one in *Leptorhynchus* Less. (but not the types of these two genera) had similar characters to the excluded species of *Ixiolaena* and that these all belonged to a new genus, which is described here under the name *Leiocarpa*.

Three independent lines of investigation suggest that, taken together, *Leiocarpa* is generically distinct from all currently recognized genera. These are the chromosome numbers (where known), the mycorrhizal associations (where known), and the morphology of the involucre bracts, carpels and other organs.

Chromosome number

The chromosome number of *Ixiolaena s.str.* has not been recorded. The few chromosome counts that have been made in the other three genera under consideration suggest that the base number in *Leiocarpa* is different from that of *Chrysocephalum* and of *Leptorhynchus* (Table 1). *Leiocarpa* appears to have polyploid numbers on a base of $x = 10$, whereas both *Chrysocephalum* and *Leptorhynchus* appear to have mostly diploid numbers on the base of $x = 12$.

Table 1. Summary of chromosome number records in *Chrysocephalum*, *Leiocarpa* and *Leptorhynchus*. Taken from Watanabe *et al.* (1999) which includes those published by Turner (1970).

Current name and recorded name		Chromosome number
<i>Chrysocephalum aff. adpressum</i> (W. Fitzg.) Anderb.		$n = 24$
<i>C. apiculatum</i> (Labill.) Steetz		$n = 12, c. 38$
<i>C. semipapposum</i> (Labill.) Steetz		$n = 12$
<i>Chrysocephalum</i> sp.		$n = 12$
<i>Leiocarpa leptolepis</i>	[as <i>Ixiolaena chloroleuca</i>]	$n = 20$
<i>Leiocarpa tomentosa</i>	[as <i>Ixiolaena tomentosa</i>]	$n = 20$
<i>Leiocarpa semicalva</i>	[as <i>Leptorhynchus ambiguus</i>]	$n = c. 38, c. 40$
<i>Leiocarpa websteri</i>	[as <i>Ixiolaena leptolepis</i>]	$n = 20, c. 21, 30$
<i>Leptorhynchus baileyi</i> F. Muell.		$n = 12$
<i>Leptorhynchus scaber</i> (Benth.) Haegi [as <i>L. medius</i>]		$n = 12$
<i>Leptorhynchus squamatus</i> (Labill.) Less.		$n = 12$
<i>Leptorhynchus waitzia</i> Sond.		$n = 12$

Mycorrhizal associations

Work by Warcup (1990) and McGee (1986) on mycorrhizal associations in the Australian Inuleae has shown that while those species of *Chrysocephalum* and *Leptorhynchus* that were studied (i.e. *C. apiculatum* (Labill.) Steetz, *C. semipapposum* (Labill.) Steetz, *C. pterochaetum* F. Muell., *Helichrysum ramosissimum* Hook. [= *Chrysocephalum* sp.], *L. squamatus* (Labill.) Less. and *L. waitzia* Sond.) form both ectomycorrhizal and vesicular-arbuscular mycorrhizal associations, those species that were examined that are here placed in *Leiocarpa* (i.e. *L. ambigua*, *L. brevicompta*, *L. leptolepis*, and *L. supina*) form only vesicular arbuscular mycorrhiza. Warcup observed that mycorrhizal relationship in general correlates with taxonomic relationship, which, if correct, suggests that those species studied that are here placed in *Leiocarpa* are generically distinct from those studied that are placed in the other two genera. The mycorrhizal relationship of *Ixiolaena viscosa* has not been recorded.

Comparative data

Chrysocephalum. The involucre bracts have a fenestrate stereome and are prominent and papery, with conspicuous stiff cilia. The anther tails are firm and long. The cypselas are not beaked and the pericarp is hyaline with two-celled papillae in which the lower cell over-tops the upper. The pappus bristles are individually deciduous. The plants are ecto- and vesicular-arbuscular mycorrhizal. Chromosome number $x = 12$.

Ixiolaena. The involucre bracts have an undivided stereome and are thin, linear and herbaceous. The anthers have delicate divided tails. The cypselas are hispid with slender twin hairs. The pappus is deciduous as a whole. The form of mycorrhizal association and the chromosome number are not recorded.

Leiocarpa. The involucre bracts have a fenestrate stereome and are entire to dentate, lacerate or woolly-ciliate. The anther tails are firm and long. The cypselas are not beaked and the pericarp is cartilaginous, glabrous and smooth, and has the appearance of many linear clear windows set into the translucent background; when mature the pericarp disintegrates into linear fragments of one to few cells. Short *et al.* (1989) noted the presence of paired myxogenic cells that are apparent in transverse section of the cypselas. These myxogenic cells probably correspond to the linear clear windows that are seen in surface view. The pappus bristles are persistent. The plants are vesicular-arbuscular mycorrhizal only. Chromosome number $x = 10$.

Leptorhynchus. The involucre bracts have a fenestrate stereome and are oblong to elliptic, hyaline and sometimes ciliate. The anther tails are delicate and branched. The cypselas are blunt or beaked and the pericarp is hyaline and has two-celled papillae in which the lower cell over-tops the upper. The pappus bristles are persistent. The plants are ecto- and vesicular-arbuscular mycorrhizal. Chromosome number $x = 12$.

Formal taxonomy

Leiocarpa Paul G. Wilson, *gen. nov.*

Herba perennis ramis lanatis. Folia linearia vel oblonga, integra. Capitula ad apices ramulorum pedunculata, homogama et discoidea, vel heterogama floribus in ambitu feminei 1-seriatis in disco bisexuales. Involucrum hemisphaericum vel turbinatum; bracteae multiseriatae, imbricatae, lineares vel lineari-acuminatae, scariosae, herbaceae, vel cartilaginaceae, laminis parvis, pallido bruneis, scariosis, non radiantibus. Corollae regulares 5-fidae (3-4-fidae in floribus femineis), tubulosae, plerumque flavidae, limbo ampliato anguste turbinato vel campanulato. Anthera longiuscule valido caudatae. Styli apice truncati vel rotundati. Achaenia subteretia vel leviter compressa, erostris, 2-4 costata; pericarpium cartilagineum, striatum, cellulae binatae translucens inter cellulae lineares dispersae, laevum vel sparse glandulosum. Pappi setae tenues, lineares vel filiformes, barbellatae, persistentes.

Typus: Leiocarpa leptolepis (DC.) Paul G. Wilson

Perennial herbs; branches variably woolly, produced into slender sparsely bracteate peduncles. *Leaves* linear to oblong. *Involucre* hemispherical to turbinate; bracts linear or linear-acuminate,

scarious, herbaceous or cartilaginous, with a narrow scarious margin; stereome fenestrate; lamina pale brown, scarious, not radiating. *Receptacle* naked, convex or conical. *Florets* bisexual or the outer female; corolla tube slender below, narrowly turbinate to campanulate above, shortly exceeding the bracts, usually yellow; lobes 5 (3 or 4 in female), smooth within. *Anther tails* long and firm. *Style apex* truncate to rounded. *Cypselas* terete or somewhat compressed, 2–4-ribbed, not beaked; pericarp cartilaginous, striate, with scattered paired linear transparent cells among linear translucent cells, smooth or sparsely glandular and with a few minute unicellular hairs. *Pappus bristles* linear to filiform, barbellate, persistent.

An Australian endemic genus of ten species.

Etymology. The generic name is derived from the Greek words – *leios* smooth and *carpos* – fruit; it refers to the smooth cypselas that are typical of this genus.

Notes. The pericarp has the appearance of containing many linear clear windows set into a translucent background. When mature, the pericarp disintegrates into linear (and presumably one-celled) fragments. Details of these cells in transverse section are given by Short *et al.* (1989).

Unlike other members of the genus, the corolla lobes of *Ixiolaena supina* are slightly papillose within and the anther tails are weak and slightly branched.

Key to species of *Leiocarpa*

- 1 Erect plant, variably cottony or woolly; leaves mostly linear to oblong
- 2 Claw of involucre bracts narrowly linear (or narrowly oblong in inner bracts), almost equal in length in outer and inner bracts
- 3 Lamina of inner involucre bracts broadly ovate; pappus bristles almost equal to corolla; older branches covered with a dense woolly indumentum that forms a silvery sheen 1. *L. leptolepis*
- 3: Lamina of inner involucre bracts slender-attenuate; pappus bristles c. 2/3 length of corolla; older branches cottony or glabrous 2. *L. brevicompta*
- 2: Claw of involucre bracts linear to narrowly oblong or narrowly ovate, markedly shorter on outer than on inner bracts
- 4 Involucre bracts glabrous or minutely glandular-puberulous, cartilaginous 3. *L. websteri*
- 4: Involucre bracts variably cottony, scarious to herbaceous or cartilaginous
- 5 Involucre 5–10 mm high; pappus bristles c. 20 or fewer
- 6 Involucre campanulate; bracts scarious and wrinkled, with a slender, acuminate, curled lamina 6. *L. gatesii*
- 6: Involucre turbinate to hemispherical; bracts herbaceous or cartilaginous at least in lower half, with a blunt to acuminate flat lamina
- 7 Involucre bracts with upper half scarious and wrinkled, pale brown; female florets without pappus 8. *L. semicalva*
- 7: Involucre bracts cartilaginous or with a short scarious tip, not wrinkled, pale green; female florets with pappus

- 8 Involucre turbinate, cypselas glabrous 4. *L. tomentosa*
 8: Involucre hemispherical; cypselas very sparsely puberulous 7. *L. panaetioides*
 5: Involucre 12–15 mm high; pappus bristles c. 40 5. *L. pluriseta*
 1: Sprawling villous plant; leaves obovate
 9 Leaves fleshy, hirsute below 9. *L. supina*
 9: Leaves papery, with sub-sessile globular glands and cottony hairs below 10. *L. serpens*

1. *Leiocarpa leptolepis* (DC.) Paul G. Wilson, *comb. nov.*

Helichrysum leptolepis DC., Prod. 6: 194 (1838). – *Gnaphalium leptolepis* (DC.) Schultz-Bip., Bot. Zeitung 3: 171 (1845). – *Ixiolaena leptolepis* (DC.) Benth., Fl. Austral. 3: 597 (1867). Type: Molles Plains, Lachlan River, New South Wales, 22 July 1817, A. Cunningham 96 (holo: G-DC, fide seen; iso: K).

Ixiolaena chloroleuca Haegi in J.P. Jessop & H.R. Toelken, Fl. South Australia 4th edn, 1551 (1986). Type: Andamooka, South Australia, 21 September 1978, E. Brown (holo: AD 97843431; iso: PERTH 0162104).

Selected specimens examined. NORTHERN TERRITORY: Huckitta Station, M. Lazarides 5945 (CANB).

SOUTH AUSTRALIA: Clayton Station, F.J. Badman 443 (CANB).

QUEENSLAND: 28 miles [c. 45 km] E of Eulo, 24 Sep. 1963, M.E. Phillips (CANB).

NEW SOUTH WALES: Cobham Station, P. Martensz 230 (CANB).

Distribution. Found in central and eastern South Australia, the Northern Territory, south-western Queensland, western New South Wales and far north-western Victoria.

Notes. When growing with *L. websteri* plants occur that are intermediate in morphology between the two species. These are presumably hybrids. For example sheet MEL 2037868, S.W.L. Jacobs 2116, from Fowlers Gap, New South Wales, consists of portions of *L. websteri*, *L. leptolepis* and the putative hybrid.

The circumscription by Bentham (1867) of this species [as *Ixiolaena leptolepis*] included material now referred to *L. websteri*. For further information see note under the latter name.

2. *Leiocarpa brevicompta* (F. Muell.) Paul G. Wilson, *comb. nov.*

Ixiolaena brevicompta F. Muell., Fragm. 1: 53 (1858). Type: Queensland, Peak Downs, F. Mueller (lecto: MEL 271239, here designated; isolecto: NSW 468205).

Selected specimens examined. SOUTH AUSTRALIA: Howica Dam, L.D. Williams 8223 (AD).

QUEENSLAND: Rayndah, W. Jones 2640 (CANB).

NEW SOUTH WALES: near Louth, C.W.E. Moore 6541 (CANB).

Distribution. Found in South Australia, Queensland and New South Wales.

Typification. Mueller cited the type locality as "In planitiebus basalticis a tractu Peak Range usque ad prata Darling's Downs". A field label attached to the lectotype chosen here has on it in pencil "*Ixiolaena?*/ Betw Dawson et Buruclt [?] / Basalt plains". A sheet label has written on it, apparently in Mueller's handwriting: "*Ixiolaena brevicompta* Ferd Muell. / a. *glabra* / Peak Downs / ferd Mueller". Mueller described the root and flowers, which are not present on this specimen, so presumably there is, or was, further syntype material that has not been seen.

3. *Leiocarpa websteri* (S. Moore) Paul G. Wilson, *comb. nov.*

Ixiolaena websteri S. Moore, *J. Bot.* 41: 98 (1903). *Type:* Coolgardie district, Western Australia, L.C. Webster (*holo:* BM, photo seen).

Ixiolaena tomentosa var. *glabrata* Sond., *Linnaea* 25: 504 (1853). *Type:* Crystall-brook [Crystal Brook], South Australia, October 1851, F. Mueller (*lecto:* MEL 271160 *p.pte.*, here designated).

Selected specimens examined. WESTERN AUSTRALIA: 15 km N of Kalgoorlie, R.J. Cranfield 9813 (PERTH).

NORTHERN TERRITORY: 32 miles [c. 51 km] N of Alice Springs, D.J. Nelson 2144 (HO).

SOUTHAUSTRALIA: Cariewerloo, H.R. Toelken 7298 (HO).

NEW SOUTH WALES: Nangara Homestead, L. Haegi 2136 (PERTH).

VICTORIA: 38 km NW of Underbool, A.C. Beauglehole 40467 (MEL).

Distribution. Found in all mainland states and territories.

Typification. The name *Ixiolaena tomentosa* var. *glabrata* Sond. is based on a collection made by Mueller at Crystal Brook. The type sheet, MEL 271160, has two labels in Mueller's handwriting which bear the name "*Leptorrhynchus tomentellus* [var.] *glabratus*" and the locality "Crystal-brook". There are two specimens on the sheet, the left-hand specimen has elliptic involucre bracts with prominent brown appendages; the right-hand specimen has narrowly oblong involucre bracts also with prominent brown appendages. I am lectotypifying on the left-hand specimen.

Bentham (1867) included *Ixiolaena tomentosa* var. *glabrata* in *I. leptolepis* along with material here referred to *L. websteri*. His circumscription was accepted by botanists until Haegi (1986) recognized that the element with densely woolly branches was specifically distinct from the remainder. Haegi therefore described *Ixiolaena chloroleuca*, but the type of this taxon unfortunately corresponds to the type of *I. leptolepis* which Haegi had not seen.

Haegi (1986) indicated that this species was very variable and that "more intensive examination may bring to light variants worthy of taxonomic recognition". I endorse these comments but I have not been able to circumscribe clearly definable taxa within the *L. websteri* complex.

Note. Very similar to *L. panaetioides* but this species has smaller heads and its involucre bracts are obviously woolly. In New South Wales the two species appear to intergrade.

4. *Leiocarpa tomentosa* (Sond.) Paul G. Wilson, *comb. nov.*

Ixiolaena tomentosa Sond. & F. Muell. ex Sond., *Linnaea* 25: 504 (1853). – *Helichrysum sonderi* F. Muell., *J. Bot. (Hooker)* 4: 121 (1866) *nom. illeg.* *Type:* Cudnaka [= Kanyaka], South Australia, F. Mueller (*lecto:* MEL 727558, here designated).

Selected specimens examined. WESTERN AUSTRALIA: Elder Creek, Warburton, A.S. George 3954 (PERTH).

NORTHERN TERRITORY: Serpentine Chalet, P.K. Latz 9873 (AD).

SOUTH AUSTRALIA: Nelshaby Reservoir Reserve, R.J. Chinnock 8723 (CANB).

NEW SOUTH WALES: 46 km SE of Broken Hill, J. Palmer 276 (CANB).

VICTORIA: Murray River, 2 km S of north-west corner of State, M.D. Crisp 6992 (CANB).

Distribution. Found in semi-arid areas of eastern Western Australia, southern Northern Territory, South Australia, western New South Wales, and western Victoria.

Typification. Sonder cited the Mueller collecting localities "Murray-scrub" and "Cudnaka" [= Kanyaka]. The lectotype cited above bears in Mueller's handwriting the name *Leptorrhynchus tomentellus* [sic.] and the locality "Cudnaka"; it agrees with the original description of *Ixiolaena tomentosa*.

Note. This species has been confused with *L. websteri* which differs in generally having smaller and somewhat hemispherical (not turbinate) capitula, and in having non-cottony involucre bracts. The distinction between the two is not always clear and some collections from Eyre Peninsula appear to be intermediate in morphology.

5. *Leiocarpa pluriseta* (Haegi) Paul G. Wilson, *comb. nov.*

Ixiolaena pluriseta Haegi in J.P. Jessop & H.R. Toelken, Fl. South Australia 4th edn, 1552 (1986). *Type:* between the lakes north of Point Sinclair, South Australia, H. Eichler 21363 (*holo:* AD 98242439).

Selected specimens examined. SOUTH AUSTRALIA: Masillon Island, N. Wace 292 (CANB); Thevenard, M.E. Phillips (CANB 010709).

Distribution. Occurs near the Head of the Bight in South Australia eastwards to Eyre Peninsula and the adjacent islands with an isolated occurrence near Morgan in the Murray Region.

Notes. Some plants have capitula with only, or almost only, female florets, some have a mixture of female and bisexual florets, while others have almost entirely bisexual florets.

This species is similar to *L. tomentosa* from which it differs in having larger capitula and larger flowers with more numerous pappus bristles.

6. *Leiocarpa gatesii* (H.B. Will.) Paul G. Wilson, *comb. nov.*

Helichrysum gatesii H.B. Will., *Proc. Roy. Soc. Victoria* ser. 2, 35: 24 tab. 5 (1922). – *Leptorrhynchus gatesii* (H.B. Will.) J.H. Willis, *Victorian Naturalist* 73: 200 (1957). *Type:* Lorne, Victoria, 7 December 1921, A.C.F. Gates (*holo:* MEL 1591145).

Selected specimen examined. VICTORIA: W of Anglesea, 5 July 1984, S.J. Platt *et al.* (CANB).

Distribution. Found in the Otway region of Victoria between Lorne and Anglesea.

Note. This species is a “fire ephemeral” (Gill 1993) and is apparently absent for long periods between fires. It was rediscovered, when thought to be extinct, by Mary White in 1984, after the bushfires of 1983 (see White 1984).

7. *Leiocarpa panaetioides* (DC.) Paul G. Wilson, *comb. nov.*

Helichrysum panaetioides DC., Prod. 6: 194 (1838); *Gnaphalium panaetioides* (DC.) Schultz-Bip., Bot. Zeitung 3: 171 (1845). – *Leptorhynchus panaetioides* (DC.) Benth., Fl. Austral. 3: 609 (1867). *Type:* wet plains of Lachlan River, New South Wales, May 1817, A. Cunningham 94 (*holo:* G-DC, *fiche seen;* *iso:* K).

Selected specimens examined. QUEENSLAND: Gilruth Plains Station, 15 Apr. 1967, R. Barker (CANB).

NEW SOUTH WALES: 20 miles [c. 32 km] W of Hay, R. Schodde 4197 (CANB); 9 miles [c. 14 km] N of Forbes, 26 Apr. 1965, B. Whitehead (CANB).

VICTORIA: Benjeroop State Forest, A.C. Beauglehole 83163 (CANB).

Distribution. Found in south-eastern Queensland, New South Wales, and Victoria.

Notes. This species is very similar to *Leiocarpa websteri* which typically has leaves that are broader than those of *L. panaetioides* while its involucre bracts are glandular puberulous (not woolly) and more rigid, however, the two taxa grade into each other and many specimens that belong to this complex cannot be confidently placed with either species.

8. *Leiocarpa semicalva* (F. Muell.) Paul G. Wilson, *comb. nov.*

Helichrysum semicalvum F. Muell., Fragm. 2: 156 (1861). – *Leptorhynchus ambiguus* Benth. var. *semicalvus* (F. Muell.) Benth., Fl. Austral. 3: 609 (1867) *comb. illeg.* – *Chrysocephalum semicalvum* (F. Muell.) Paul G. Wilson, *Muelleria* 7: 520 (1992). *Type citation:* In rupibus tractus Barrier Range, Beckler; in montibus McDonnell Ranges Australiae centralis, J.M. Stuart. *Type:* Macdonnell Range, [Northern Territory], J.M. Stuart, (*lecto:* MEL 108093, here designated).

Typification. I have seen only the J.M. Stuart syntype of *Helichrysum semicalvum*; this has leaves that are entire, revolute on the margins. woolly beneath and prominently scabrid with glandular hispid hairs above, the female florets are epappose. In his original description, Mueller describes the female florets as having no, one, or few pappus bristles, whereas in material I have examined of this species, as lectotypified here, the female florets are without bristles, therefore it is possible that the other syntype represents a different taxon.

8a. *Leiocarpa semicalva* (F. Muell.) Paul G. Wilson subsp. *semicalva*

Helichrysum ambiguum Turcz., Bull. Soc. Imp. Naturalistes Moscou 24(1): 195 (1851), *nom. illeg., non* (Ray) Presl (1826). – *Leptorhynchus ambiguus* Benth., Fl. Austral. 3: 609 (1867). – *Chrysocephalum ambiguum* (Benth.) Anderb., *Opera Bot.* 104: 119 (1991). *Type:* Nova hollandia [Western Australia], J. Drummond 3rd coll. n. 121 (*syn:* MEL 108096) and 4th coll. n. 220 (*syn:* MEL 108098).

Selected specimens examined. WESTERN AUSTRALIA: Tom Price, 19 Jan. 1968, A.C. Robinson (CANB).

NORTHERN TERRITORY: Ruby Gap, R.W. Purdie 2381 (CANB).

SOUTH AUSTRALIA: Bibliando Station, D. Chinner 4 (CANB).

NEW SOUTH WALES: 45 km from Broken Hill towards Tibooburra, A.M. Lyne 1835 (CANB).

Distribution. Widespread in arid and semi-arid Australia.

8b. *Leiocarpa semicalva* subsp. *tenuifolia* Paul G. Wilson, *subsp. nov.*

Ixiolaena sp. 1, T.D. Stanley & E.M. Ross, Fl. South-eastern Queensland 2: 542 (1986).

Subspecies haec ab. subsp. *semicalva* differt foliis longis tenuibus, a quibus supra glabrescentibus, infra gossypinis.

Typus: Boatman Station, Queensland, 20 March 1947, S.L. Everist 2760 (*holo:* BRI 339534).

Erect perennial to 45 cm high. Stems slender, woolly. Leaves linear-acuminate, margins revolute, c. 5 cm long, diminishing upwards, glabrescent above, cottony below. Capitula terminal to slender peduncles. Involucre hemispherical, c. 6 mm high; bracts c. 4 seriate, narrowly oblong to linear, somewhat woolly, the outer largely scarious and straw-coloured, the inner with herbaceous claw and weak, acuminate and somewhat lacerate scarious lamina. Outer florets female with slender corolla; pappus absent. Bisexual florets numerous; corolla c. 5 mm long, narrowly campanulate above, almost glabrous. Cypsela c. 1.5 mm long, smooth. Pappus bristles numerous, capillary, almost equal to corolla, barbellate, the barbs longer at apex.

Selected specimens examined. QUEENSLAND: Glenoie, S.L. Everist 1747 (BRI); Tatala, S.L. Everist 3419 (BRI); Ambathala Range, 9 km E of Miles, D. Halford Q2065A (BRI); 50 km E of Adavale, Ambathala Range area, C. Sandercoe A315 (BRI).

Distribution. Found in south-east Queensland; occurring in *Eucalyptus*–*Acacia* woodland in sandy loams.

Etymology. The epithet is derived from the Latin – *tenuis* slender and *folium* – leaf, with reference to the slender leaves of this subspecies.

Notes. Subspecies *tenuifolia* differs from subsp. *semicalva* in having long, linear leaves which are smooth and glabrescent above and cottony below. A collection from “between Bourke and Cobar”, New South Wales (MEL 600854) agrees with subsp. *tenuifolia* except for the presence of both glandular and cottony hairs on the leaves and stems; it may represent a southern variant of this taxon.

8c. *Leiocarpa semicalva* subsp. *vinacea* (Haegi) Paul G. Wilson, *comb. nov.*

Helichrysum ambiguum Turcz. subsp. *vinaceum* Haegi, Fl. South Austral. 3: 1535 (1986). – *Chrysocephalum semicalvum* subsp. *vinaceum* (Haegi) P.S. Short, *Muelleria* 7: 520 (1992). *Type:* Amoorinyinna Hill, c. 26 km south-west of Everard Park Homestead, South Australia, 13 September 1963, H.J. Eichler 17479 (*holo:* AD, *n.v.*).

Distribution. Found in the far north of South Australia.

Notes. This subspecies was described from a plant collected in the far north of South Australia. Much of the material of *L. semicalva* collected in the mountain ranges of the southern portion of the Northern Territory and in the Rawlinson Range district of Western Australia agrees with the brief original description of subsp. *vinacea* except for the branches which do not have the vinaceous coloration mentioned by Haegi.

9. *Leiocarpa supina* (F. Muell.) Paul G. Wilson, *comb. nov.*

Ixiolaena supina F. Muell., *Trans. Proc. Victorian Inst. Adv. Sci.* 37 (1855). *Type:* Insulahalmaturorum [Kangaroo Island], South Australia, *F. Mueller* (*lecto:* MEL 271180, here designated).

Selected specimens examined. SOUTH AUSTRALIA: Flinders Chase Conservation Park, Kangaroo Island, *L. Haegi* 2304 (CANB).

TASMANIA: Dover Island, *J.S. Whinray* 1110 (CANB); Deal Island, *J.S. Whinray* 1243 (CANB).

Distribution. This species occurs on the south coast and off-shore islands of South Australia, and on the islands of Bass Strait, Tasmania.

Typification. Mueller gave the following locality and habitat details for the species: "Amongst rocks on the south coast of Kangaroo Island". The lectotype bears a label with a note in Mueller's handwriting: "Inter rupus litoris australis arenosi insulae halmaturorum promineus, frequens".

Note. *Leiocarpa supina* varies considerably in morphology between the disjunct localities both in the size of the capitula and in their indumentum, but there is no clear suggestion of separation into distinct species or subspecies.

10. *Leiocarpa serpens* (Everett) Paul G. Wilson, *comb. nov.*

Chrysocephalum serpens Everett, *Telopea* 8: 311 f. 1 (1999). *Type:* Carrae State Forest, New South Wales, 7 December 1987, *J. Everett* 1014 & *D. Binns* (*holo:* NSW, *n.v.*).

Selected specimen examined. NEW SOUTH WALES: Hillgrove Gorge, *G.L. Davis* (NSW 470087).

Distribution. Found in the coastal ranges of New South Wales north of Taree where growing on skeletal soils of metamorphosed sedimentary rock (*vide* Everett *op. cit.*).

Note. This species differs from other members of the genus in having a conic, not convex, receptacle.

Acknowledgements

Phil Short (DNA) kindly provided comments on a draft of this paper and information concerning some species. Support for this project was provided by the Australian Biological Resources Study.

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Leptorhynchos (Asteraceae: Gnaphalieae), notes, new taxa, and a lectotypification

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Abstract

Wilson, Paul G. *Leptorhynchos* (Asteraceae: Gnaphalieae), notes, new taxa, and a lectotypification. *Nuytsia* 13(3): 607–611 (2001). Two new species of *Leptorhynchos* Less. are described, *L. orientalis* Paul G. Wilson which is found in South Australia, New South Wales, and Victoria, and *L. melanocarpus* Paul G. Wilson which is restricted to gypseous mounds on a salt lake in South Australia. The typification of the generic name is discussed and a lectotype is chosen for *L. tenuifolius* F. Muell.

Introduction

Leptorhynchos Less. is an endemic southern Australian genus of the Asteraceae, tribe Gnaphalieae. Ten species are recognised including the two here described. During the preparation of a “Flora of Australia” treatment the various ways in which *Leptorhynchos* had been delineated by botanists during the 19th and 20th centuries were investigated, particularly the manner in which it had been discriminated from *Helichrysum* Mill. *s.l.*, *Ixiolaena* Benth., and *Chrysocephalum* Walp.

The application of the generic name *Leptorhynchos* (1832) has been confused since its inception. Haegi (1986) and Anderberg (1991) discussed this uncertain taxonomic situation and Wilson (1998) noted how the identity of *L. linearis* Less., one of the two syntype species, had been misinterpreted since the name had been misapplied by Bentham (1867). The relationship of *Leptorhynchos* to *Ixiolaena* Benth. and *Chrysocephalum* Walp., the genera with which it has most commonly been confused, was discussed by Wilson (1998, 2000) where it was shown that these genera, when given a circumscription slightly different to that previously applied, are clearly distinct. He further explained how the syntype species of *Leptorhynchos*, *L. squamatus* (Labill.) Less. and *L. linearis*, are not only congeneric but also conspecific.

The difficulty in applying the name originated when Lessing described *L. squamatus* (Labill.) Less. (the future lectotype) and gave as its basionym “*Conyza squamata* Lab.” instead of *Chrysocoma squamata* Labill. That the latter name was actually intended, was apparent from an examination of the literature cited by him (which did not include that of Labillardiere) in which the correct genus name had been used. A further problem was that Lessing, in describing the cypselas, stated “*apice in rostrum*

tenu et breve continuum” and from this character he derived the generic name. However, neither of the types of the two species names included by Lessing in his genus have cypselas with a slender rostrate apex. It is possible that Lessing saw immature material or that at least one of the specimens he examined was incorrectly determined.

Typification of the name *Leptorhynchos*

The lectotypification of the name *Leptorhynchos* was briefly discussed by Wilson (1998), however, the conclusion he then reached appears to be incorrect and a further note is required.

Two species were recognized by Lessing, *L. squamatus* and *L. linearis*. It was suggested by Farr *et al.* (1979) that Pfeiffer (1872), in citing only “*Conyza squamata* Labill” (*sic.*), under *Leptorhynchos* may have designated this name as lectotype. That argument was rejected by Wilson who accepted as lectotype *L. linearis*, based on the lectotypification by Anderberg (1991). Recently a colleague has brought to my attention the entry in Stafleu & Cowan (1983: 224) under Pfeiffer “Nomenclator Botanicus”, where it is pointed out that occasional copies of this work contain a Preface in which Pfeiffer stated that “single species are mentioned only when they serve as type of new genera or sections” [their translation]. Since this is the situation with *Leptorhynchos* its lectotype must be accepted as *L. squamatus*.

Taxonomy

Leptorhynchos melanocarpus* Paul G. Wilson, *sp. nov.

Leptorhyncho scabro (Benth.) Haegi affinis sed foliis lanatis, bracteis exterioribus lineari-acuminatis, interioribus apiculo hyalino anguste triangulari ornato, cypselis nigris anguste rostellatis, rostro in statu maturo caduco differt.

Typus: Lake Acraman, Gawler Range, South Australia, 26 September 1989, R. Bates 20749 (*holo*: AD 98942266; *iso*: K, NSW, PERTH 05170001).

Erect multi-stemmed *annual* to 30 cm high; branches woolly; peduncle slender, glabrescent. *Leaves* slender terete, 1–2.5 cm long, obtuse, revolute, densely woolly. *Involucre* broadly turbinate, c. 10 mm high, bracts multiseriate, eciliate; outer and intermediate bracts linear-acuminate, with broad hyaline scabridulous denticulate margins and narrow brown glandular stereome; inner bracts with a narrow linear green cartilaginous glandular stereome, broad hyaline margins, and scarious pale brown acuminate lamina c. 2 mm long. *Florets* bisexual. *Corolla* c. 5 mm long, glandular-pubcrulous. *Cypselas* narrowly ellipsoid, c. 1.8 mm long, densely papillose, black, abruptly narrowed into a slender smooth caducous beak 3–6 mm long. *Pappus bristles* numerous, filiform, shorter than corolla, dentate.

Distribution and habitat. Known only from Lake Acraman in the Gawler Range, South Australia, where it grows on gypseous mounds that form islands in the lake.

Conservation status. This very distinctive species is known only from a single collection which came from a particular habitat, a gypseous mound. It is probable that *L. melanocarpus* is restricted to this

habitat, and possible that it only occurs in the Lake Acraman area. Due to lack of information the species could have the Conservation Code (Briggs & Leigh 1996) of 1K, of which the "K" indicates that it is poorly known and may be vulnerable or even endangered.

Etymology. The specific epithet is derived from the Greek words *melano* – black and *carpos* – fruit and refers to the black cypsels that are found in this species.

Affinities. This species is unique in possessing a caducous beak to the cypselas, which is also unusual in being black when mature. These characters clearly distinguish it from *S. scaber* (Benth.) Haegi to which species it is most similar.

Leptorhynchos orientalis* Paul G. Wilson, *sp. nov.

Leptorhyncho scabro (Benth.) Haegi affinis sed bracteis involucri parte hyalina laevibus (non scabridulis) et apiculo hyalino bractearum interiorum minuto vel carenti (non prominenti) differt.

Typus: Cockatgedong Station, 9 miles [c. 15 km] west of Urana, New South Wales, 1969, *D. & I. Parer* (*holo:* CANB 196001; *?iso:* CANB 196000, dated 23 Oct. 1969).

Erect single to multi-stemmed *annual* to 30 cm high. *Branches* slender, minutely puberulous with gland-tipped and septate hairs. *Peduncle* slender, densely glandular puberulous beneath the capitulum, otherwise glabrescent, bearing a few scattered hyaline bracts. *Leaves* linear, 1–2 cm long, acute, margins recurved, with scattered minute gland-tipped hairs and short (to 0.2 mm) whitish septate hairs. *Involucre* broadly turbinate, c. 8 mm high, bracts multiseriate, eciliate; outer and intermediate bracts very narrowly triangular, hyaline, smooth, with reddish brown glandular stereome at base; inner bracts c. 7 mm long with linear green cartilaginous glandular stereome and narrow hyaline margins; lamina absent or represented by a hyaline erose apiculum to 0.5 mm long. *Florets* bisexual. *Corolla* c. 6 mm long, sparsely glandular-puberulous, narrowly turbinate above, very narrowly tubular below. *Cypselas* compressed-ellipsoid, c. 1.8 mm long, densely papillose, reddish brown, abruptly narrowed upwards into a slender almost smooth persistent beak 3–4 mm long. *Pappus bristles* numerous, filiform, shorter than corolla, minutely denticulate.

Selected specimens examined. SOUTH AUSTRALIA: Uley, *anon.*, (AD97625334); Kapunda, 24 Sep. 1938, *E.H. Ising* (AD); Naracoorte, 26 Nov. 1882, *O. Tepper* (AD); Hallet Cove, 26 Aug. 1906, *S.A. White* (AD).

NEW SOUTH WALES: Morundah, S of Narrandera, *P. Foreman* 266 (MEL); Urana, *D. Mallinson* 468 (CANB); Zara Wangancilla via Hay, Oct. 1917, *E. Officer* (NSW); SW of Hillston, *M.F. Porteners* 9210107 (NSW).

VICTORIA: Swan Hill, *B.W. Gummow* (MEL); Wangaratta, 1891, *M. Henley* (CANB); Stawell, 1893, *W.E. Mathews* (MEL); Coleraine, *H.M.R. Rupp* 97 (MEL); Moyston, *D. Sullivan* 38 (MEL); Terrick Terrick National Park, *N.G. Walsh* 4693 (MEL); Walpeup, *H.B. Williamson* 1572 (MEL); Garfield, Oct. 1925, *H.B. Williamson* (CANB).

Distribution. This species has been recorded from southern Eyre Peninsula in South Australia, eastwards to southern New South Wales and central and western Victoria.

Habitat. Recorded as growing in woodland or grassland, sometimes on the margins of swamps.

Conservation status. This species appears to warrant a conservation code of 1E (Briggs & Leigh 1996). It is evidently rare in New South Wales and extremely rare in Victoria where I am aware of only one recent (post 1925) collection. It is possibly also rare in South Australia, for the most recent collections are from Kapunda where it was found by both E.H. Ising and J.B. Cleland on 24 September 1938.

Etymology. The epithet – *orientalis* is Latin for eastern, since the species is found in eastern Australia.

Affinities. *Leptorhynchus orientalis* differs from *Leptorhynchus scaber*, with which it has been confused, in having smooth surfaces to the hyaline portion of the involucre bracts and having inner involucre bracts with only a very short hyaline erose apiculum (to 0.5 mm long), or this apiculum is absent. In *L. scaber* the hyaline portion of the involucre bracts is minutely scabridulous and the inner bracts have a hyaline apiculum c. 2 mm long.

Notes. *Leptorhynchus scaber* has (or had) a similar distribution to that of *L. orientalis* in far western New South Wales and in far western Victoria. The only New South Wales records I have seen are in the National Herbarium of Victoria (MEL) where it is represented by two nineteenth century collections from Silvertown. The three records seen from Victoria, also in MEL, were collected in the late 19th or early 20th century, i.e. Lower Glenelg River (1891), the Shire of Lowan (1899), and Jeparit (1912). Therefore *L. scaber* may no longer be found in these two States. Apart from the collections from New South Wales and Victoria *L. scaber* is a coastal, or near-coastal, species and it would be instructive to establish the conditions under which the inland plants were growing.

Leptorhynchus tenuifolius F. Muell., Fragm. 1: 52 (1858). *Type:* Australia felix [Victoria, F. Mueller] (*lecto:* MEL 248223, here chosen).

Notes. When describing new species in the early numbers of his "Fragmenta", Mueller appears to have only given the name of the collector when it was someone other than himself, unless he and another botanist had both collected the same species in which case each of them would be cited. In the case of *L. tenuifolius* no collector was given which presumably means that Mueller had collected it. All specimens in herb. MEL that appear to have been collected prior to its publication in 1858 are either indicated as being Mueller's own collections or are labelled by him "Austr. felix" without collector or date.

I have selected as lectotype a sheet on which are attached a number of excellent specimens of this species; the sheet bears a label that has been annotated by Mueller "*Leptorhynchus tenuifolius*/ferd. Mueller/Austr. felix." and was seen by G. Bentham. This particular spelling of *Leptorhynchus* was the orthographic variant adopted by Mueller throughout his career.

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Acknowledgement

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CONSERVATION CODES FOR WESTERN AUSTRALIAN FLORA

R: Declared Rare Flora – Extant Taxa (= Threatened Flora = Endangered + Vulnerable)

Taxa which have been adequately searched for, and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such, following approval by the Minister for the Environment, after recommendation by the State's Threatened Species Scientific Committee.

X: Declared Rare Flora – Presumed Extinct Taxa

Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such, following approval by the Minister for the Environment, after recommendation by the State's Threatened Species Scientific Committee.

1: Priority One – Poorly Known Taxa

Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals, etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

2: Priority Two – Poorly Known Taxa

Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

3: Priority Three – Poorly Known Taxa

Taxa which are known from several populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in need of further survey.

4: Priority Four – Rare Taxa

Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5–10 years.

Referees for Volume 13

The assistance of referees in providing expert review of papers submitted to *Nuytsia* is gratefully acknowledged. The referees consulted for Volume 13 are listed below. Each paper was also refereed internally by *Nuytsia* Committee members or other staff members of the Department of Conservation and Land Management.

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Notes for Authors

The aim of *Nuytsia* is to publish original papers on systematic botany with preference given to papers relating to the flora of Western Australia. All papers are refereed and the Editorial Advisory Committee reserves the right to reject papers. Opinions expressed by authors are their own and do not necessarily represent the policies or views of the Department of Conservation and Land Management.

After final acceptance of papers, authors are requested to provide discs readable directly by IBM computer or internet attachments. Wherever possible, the MS-WORD software should be used. Original figures should not be lettered but accompanied by copies indicating lettering. Page proofs will be forwarded to authors for checking. Twenty reprints of each paper will be provided free of charge; no additional copies may be ordered.

Style and layout should follow recent numbers of *Nuytsia*. Within a paragraph two spaces are required between sentences; after colons, semicolons, commas and dashes a single space is required. Italics should be used for formal taxonomic names, from the genus level down to the lowest infraspecific categories, and for collectors' names when citing specimens. Incidental Latin words in the text should be italicized but not the Latin diagnosis.

Title. Should include the family name of the genera or species treated, but not authorities. New taxa should be named if not too numerous. The type of paper (e.g. revision, synopsis) and geographic area of study should be given where appropriate.

Structure of papers. Authors are encouraged to use the conventional structure of scientific papers, especially when a complete study, such as a revision, is being reported.

(1) **Abstract.** Should be indented and commence with bibliographic information. New taxa, combinations and names should be listed with their authorities. The major contents of the paper should be concisely summarized but no additional material given.

(2) **Introduction.** Should give some background information and state the purpose of the paper.

(3) **Methods or Materials and methods.** May include the method of drawing up the description from specimens, extent of search for types and discussion of concepts of taxonomic categories.

(4) **Results or Taxonomy or Taxonomic treatment** or various alternative headings as appropriate to the data being presented in the paper.

(5) **Discussion.** A discussion section should be considered, which would include some or all of the following: a summary of the findings emphasizing the most significant; interpretation of the results in the light of other relevant work; statement of new problems which have arisen; advising of aspects which are to be followed up; suggestion of topics which others might usefully pursue; prediction and speculation.

Short Communications. These are short concise contributions, usually with few or no main headings. They lack an abstract and authors' names and addresses are placed at the end.

Headings. All headings should be mainly in lower case, major headings centred and bold, secondary headings (where required) left-justified and bold, and minor headings left-justified and italicized.

Keys. May be either indented (e.g. *Nuytsia* 11: 94) or bracketed (e.g. *Nuytsia* 11: 55–56). Indented keys involving more than nine levels of indentation should be avoided. Where a key is indented, tabs should be used and not space bars.

Species treatments. Use of certain named paragraphs, or sets of paragraphs, for matter following the descriptions is encouraged. The desired sequence and examples of commonly used headings are shown below. Italicized headings should be followed by text on the same line.

(1) Taxon name (in bold) and authority. For previously published taxa this should be followed by the reference, nomenclatural synonyms (if any) and *Type*: heading with full type details.

(2) Other synonyms with their type details, significant manuscript or phrase names. Recent papers should be consulted for examples of an appropriate format for citing synonyms.

(3) Latin diagnoses (for new taxa – not indented).

(4) *Typus*: (for new taxa – not indented).

(5) English description (indented).

(6) *Other specimens examined* or *Selected specimens examined* as appropriate. The number of specimens cited for each taxon should not exceed 20. Western Australian specimens should be cited first followed by any from other states in the order: Northern Territory, South Australia, Queensland, New South Wales, Victoria, Tasmania. Within each region, the specimens cited should be placed in alphabetical order according to the collectors' surnames. For each specimen the order of the details given should be as follows: locality, date, collector's name (in italics) and number, herbarium (in brackets).

(7) *Distribution*.

(8) *Habitat*.

(9) *Phenology* or *Flowering period*.

(10) *Conservation status*. Department of Conservation and Land Management Conservation Codes for Declared Rare and Priority Flora should be cited for any endangered or rare Western Australian plants.

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Standard abbreviations. When abbreviations are used, the following standards should be followed.

(1) Author abbreviations. Follow Brummitt, R.K. & Powell, C.E. (1992). "Authors of Plant Names." (Royal Botanic Gardens: Kew.).

(2) Book titles. These should not be abbreviated in the references but any literature citations in the text should follow Green, J.W. (1985). "Census of the Vascular Plants of Western Australia." 2nd edn. pp. 20–24. (Department of Agriculture: Perth.). A more complete list of book title abbreviations is given in Stafleu, F.A. & Cowan, R.S. (1976–83). "Taxonomic Literature." 2nd edn. (Bohn, Scheltema & Holkema: Utrecht.), but capital initial letters need to be used in *Nuytsia*.

(3) Journal titles. Follow Lawrence, G.H.M. *et al.* (1968). "B-P-H. Botanico-Periodicum-Huntianum." (Hunt Botanical Library: Pittsburgh.)

(4) Dates and directions. Generally should not be abbreviated except under the *Specimens examined* section. In that section, dates should be written in full only if they have less than five letters (e.g. July), otherwise should be shortened to the first three letters and a stop (e.g. Oct.), while compass directions should be abbreviated to capital letters with no stops (e.g. N and SSW).

(5) Other abbreviations. Standard abbreviations for measurements (e.g. mm), Latin abbreviations (e.g. *c.*, *nom. illeg.*), mountains and roads (e.g. Mt Kosciuszko, Brooke Rd) are used in *Nuytsia*. Other abbreviations, especially ones that are ambiguous (e.g. Pt), should be avoided.

Figures. Numbers should follow a single sequence including maps.

References. Citation of references in the text should give the author's surname and date (e.g. Smith 1963) and full details should be given in the reference section. This format is also recommended to replace the traditional abbreviations for references listed under taxonomic names, for example using Benth. (Bentham 1878: 234) rather than Benth., Fl. Austral. 7: 234 (1878).

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